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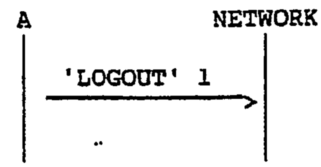
14 LOGOUT

The A-party generates 'LOGOUT' according to the criteria and with the structure stated in Appendix A.

Dialogue 14.1:

Subscription initiates log-out.

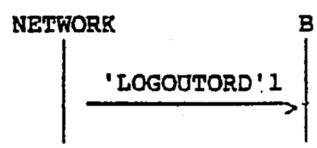


Dialogue 14.2:

Network initiates logout.

The subscription has sent a LOGINREQ from a terminal but is still registered as logged-in to another terminal. The network will then send LOGOUTORD to the old terminal according to the criteria and with the format stated in Appendix A.

The personal subscription should immediately be deleted from the B-party's flexlist.



If the network has sent a LOGOUTORD and the old terminal did not receive it, the LOGOUTORD is repeated when the subscriber sends a message next time.

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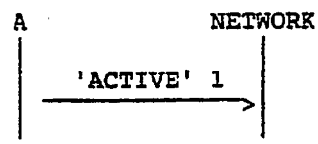
15 ACTIVATION

The A-party generates 'ACTIVE' according to the criteria and with the format stated in Appendix A.

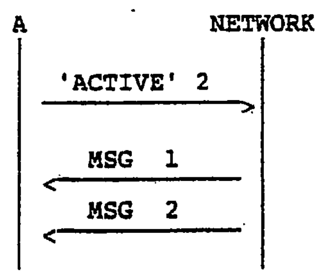
Dialogue 15.1:

Activation is approved and the mailbox is empty.



Dialogue 15.2:

Activation is approved and there are packets in the mailbox, both for the terminal and the personal subscription.



MSG 1 and 2 are packets (MPAK) that has been stored in the network mailbox while the terminal has been inactive. Each packet sent out from the mailbox is delayed a certain time in order not to overload the terminal.

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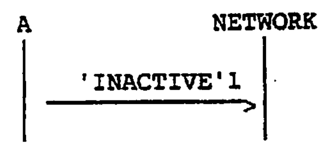
16 INACTIVATION

The A party generates 'INACTIVE' according to the criteria and with the format stated in Appendix A.

<u>Dialogue 16.1:</u>

Inactivation.



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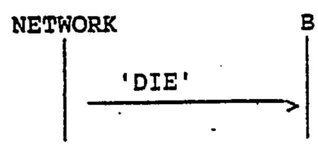
17 DIE - LIVE

The network generates 'DIE' and 'LIVE' according to the criteria and with the format stated in Appendix A.

when the terminal receives 'DIE' it is not allowed to send any user traffic to the network, until a 'LIVE' has been received. User traffic is defined as packets included in the packet classes; PSUBCOM, PSOSCOM and CSUBCOM. The terminal may send DTESERV packets.

Dialogue 17.1:

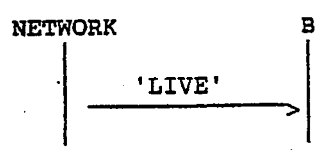
The terminal may not send user traffic.



'DIE' is stored in the network mailbox if the B-party is not active. The packet is sent out according to Dialogue 15.2 when the B party is active again.

Dialogue 17.2 :

The terminal may send packets again.



'LIVE' is stored in the network mailbox if the B-party is not active. The packet is sent out according to dialogue 15.2 when the B-party is active again.

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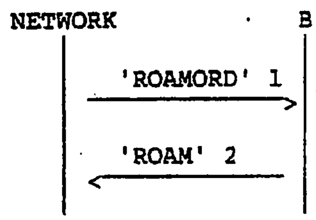
18 ROAMING

Dialogue 18.1:

The network requests the terminal to send a ROAM packet.

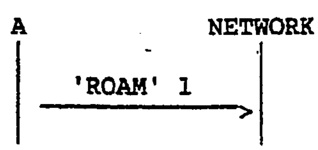
The network generates 'ROAMORD' according to the criteria and with the format stated in Appendix A.



The B-party generates 'ROAM' 2 according to the criteria and with the format stated in Appendix A.

Dialogue 18.2:

The A-party generates 'ROAM' spontaneously according to the criteria and with the format stated in Appendix A. A spontaneously generation of a ROAM packet is initiated from the roaming procedure described in the mobile terminal data link layer.



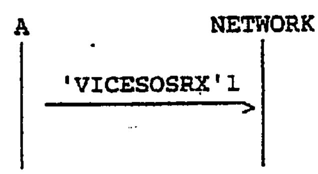
19 RE-DIRECTION OF EMERGENCY MESSAGES

This is used when the emergency messages should be sent to the alternative emergency receiver.

The A party generates 'VICESOSRX' according to the criteria and with the format stated in Appendix A.

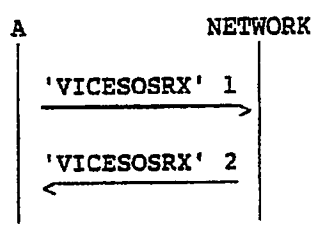
Dialogue 19.1:

The re-direction is approved.



Dialogue 19.2:

The 'VICESOSRX' is returned from the network.



a) Re-direction cannot/may not take place.

'VICESOSRX' 2 is returned with traffic state =ILLEGAL

b) The network is overloaded.

'VICESOSRX' 2 is returned with traffic state = CONGEST

c) A technical fault may have occurred.

'VICESOSRX' 2 is returned with traffic state = ERROR

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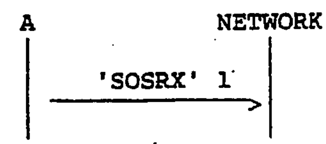
20 CANCEL RE-DIRECTION OF EMERGENCY MESSAGES

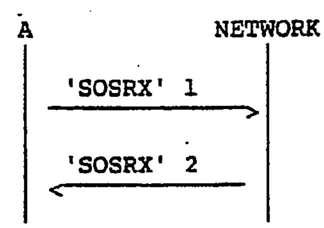
<u>Dialogue 20.1:</u>

The re-direction is cancelled.



<u>Dialogue 20.2:</u>

The cancellation of the re-direction cannot/may not be accepted.



'SOSRX' 2 is returned with traffic state = ILLEGAL

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21 UPDATING GROUPLIST

Dialogue 21.1:

The network generates 'GROUPLIST' according to the criteria and with the format stated in Appendix A.

```
NETWORK                  B
   |                     |
   |   'GROUPLIST' 1     |
   |  ---------------->  |
   |                     |
```

'GROUPLIST' is stored in the network mailbox if the B party is not active. The packets are sent out according to dialogue 15.2 when the B party is active again.

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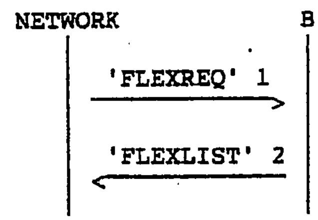
22 UPDATING THE LIST OF PERSONAL SUBSCRIPTIONS

Dialogue 22.1:

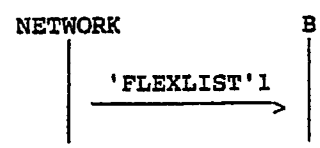
The network generates 'FLEXREQ' according to the criteria and with the format stated in Appendix A.



'FLEXLIST' is generated according to the criteria and with the format stated in Appendix A.

Dialogue 22.2:

The network generates 'FLEXLIST' according to the criteria and with the format stated in Appendix A.

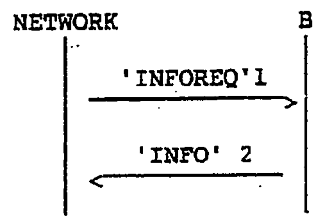


'FLEXLIST' is stored in mailbox if the B party is not active. The packet is sent out according to dialogue 15.2 when the B party is active again.

23 TECHNICAL INFORMATION

Dialogue 23.1:

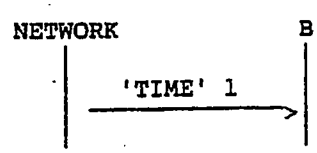
The network generates 'INFOREQ' according to the criteria and with the format stated in Appendix A.



24 TIME INFORMATION

Dialogue 24.1:

The network generates 'TIME' according to the criteria and with the format stated in Appendix A.



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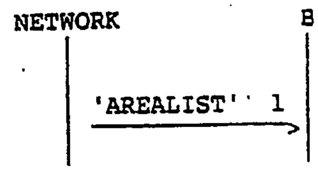
25 UPDATING AREALIST

<u>Dialogue 25.1:</u>

The network generates 'AREALIST' according to the criteria and with the format stated in Appendix A.

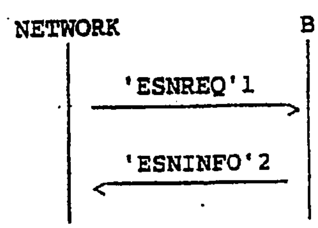


'AREALIST' is stored in the network mailbox if the B party is not active. The packets are sent out according to dialogue 15.2 when the B party is active again.

26 ELECTRONIC SERIAL NUMBER CHECK

<u>Dialogue 26.1:</u>

The network generates 'ESNREQ' according to the criteria and with the format stated in Appendix A.



Dokumentnamn			
		REQUIREMENT SPECIFICATION	1(37)
Uppgjord Prepared: ET/SYS PES	Faktaansvarig Subject responsible: ET/SYS PES	Nr No: 53/1056-A 296 5171/2 Ue	
Dokansv/Godkänd Doc respons/approved: ET/SYSC STT STT		Datum Date: 1990-02-23 Rev: A	Fil File: MTS09C.2
Benämning: Cantel Mobitex		Titel: MOBITEX Network layer for terminals Appendix C. Logical description	

ABSTRACT

This document contains the logical description for the network layer for mobile terminals connected to the MOBITEX system.

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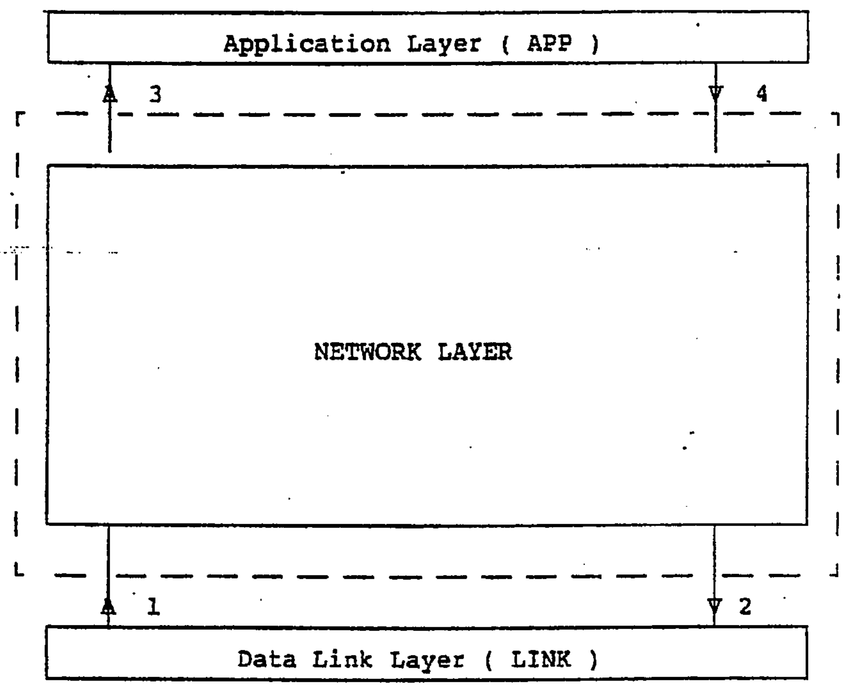
1 GENERAL

1.1 DATA FLOW DIAGRAM

The data flow diagram below shows the interaction between the network layer and the other two layers; the data link layer and the application layer.



Signals to/from Data Link Layer.

-1- MPAK_transmitted, MPAK_not_transmitted, MPAK_received, roaming, activation

-2- MPAK_to_transmit, MPAK_to_retransmit, speech_on, speech_off, order_to_return_MPAK, group_list_information, area_list_information

Signals to/from Application Layer.

-3- MPAK_received, returned_MPAK_with_code, die, live, buffer_full

-4- MPAK_to_transmit, hook_on, hook_off, power_off, manual_mode_on, MPAK_to_retransmit

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1.2 TERMINOLOGY

P_ / F_	In this logical description, all procedures starts with "P_", and all functions with "F_".
input_signal	The network layer has an input queue. A signal from this input queue is called "input_signal".
wait_for_input_signal	The network layer is waiting until un input_signal is available.
save_signal	Restoring the signal into the queue. This is done when you expect a certain signal. By repeating input_signal and save_signal, you can search in the input queue for certain signals. All saved signals are available when an input_signal follows after an input_signal without any save_signal between. See chapter 'Queue handling'.
ignore_signal	No further handling of this signal, except that the signal should be deleted.
grouplist	Area where group MAN are stored. This list should be stored also during power off.
flexlist	Area where personal subscription MAN are stored. This list should be stored also during power off.
permanent_list	Total area to be continuously stored. In this area terminal MAN, serial number, group list, flexlist, die_state and live_state are stored. The checksum is calculated based on this list.
grouplist_received_flag	Indication of a correct permanent list and that a MPAK:GROUPLIST is received or not.
active_delay_power_up	Activation delay concerning power-up and manual radio mode. See R1-06.
active_delay_lost_contact	Activation delay concerning lost contact. See R1-06.
power_off_ready	Flag to indicate that the network layer is ready to be closed.

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manual_mode	Flag to indicate that the mobile station is in manual mode.
buffer_full_flag	Indication of buffer full.
emergency_flag	Indication of an activated emergency. When application layer receive an emergency signal, this flag is raised. Now the network layer can handle the priority of emergency in the terminal.

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1.2 SIGNALS

MPAK_to_transmit	MPAK received from the application layer or MPAK to the data link layer to be transmitted.
MPAK_received	MPAK received by the data link layer or MPAK to be sent to the application layer.
MPAK_transmitted	MPAK successfully transmitted by the data link layer.
MPAK_not_transmitted	MPAK not transmitted by the data link layer.
MPAK_to_retransmit	MPAK from the application layer to the data link layer to be retransmitted (special treatment in the data link layer).
roaming	Order to the network layer to send an MPAK:ROAM.
activation	Start activation timeout (after power-on or lost contact with base) given in R1-06.
speech_on	Order to the data link layer to set mode speech_on.
speech_off	Order to the data link layer to set mode speech_off.
order_to_return_MPAK	Order to the data link layer to stop sending an MPAK, and return the MPAK to the network layer.
group_list_information	Group list information to the data link layer.
area_list_information	Area list information to the data link layer.
returned_MPAK_with_code	Returned MPAK with code information from the network layer. The code shows why the MPAK was returned.

hook_on	Hook_on signal from the application layer.
hook_off	Hook_off signal from the application layer.
die	A signal informing that the network layer has received an MPAK:DIE. All user traffic is stopped and returned to the application layer.
live	A signal informing that the network layer has received an MPAK:LIVE. User traffic from the application layer can be handled.
buffer_full	Queue for incoming messages is full. Incoming and outgoing traffic from/to the MOBITEX network is stopped. The network layer tries to send MPAK:INACTIVE. Application layer is informed. When the message buffer has space for at least 6 messages, according to specification R1-09, the buffer_full_flag is reset and incoming and outgoing traffic is resumed.
power_off	The application layer wants to turn the network layer off. The network layer tries to send an MPAK:INACTIVE.
power_off_timeout	Internal timeout to indicate that the network layer is ready to be turned off.
manual_mode_on	The application layer wants to turn over to manual radio mode. The network layer tries to send an MPAK:INACTIVE.
manual_mode_on_timeout	Internal timeout to indicate that the network layer is ready to turn over to manual radio mode.

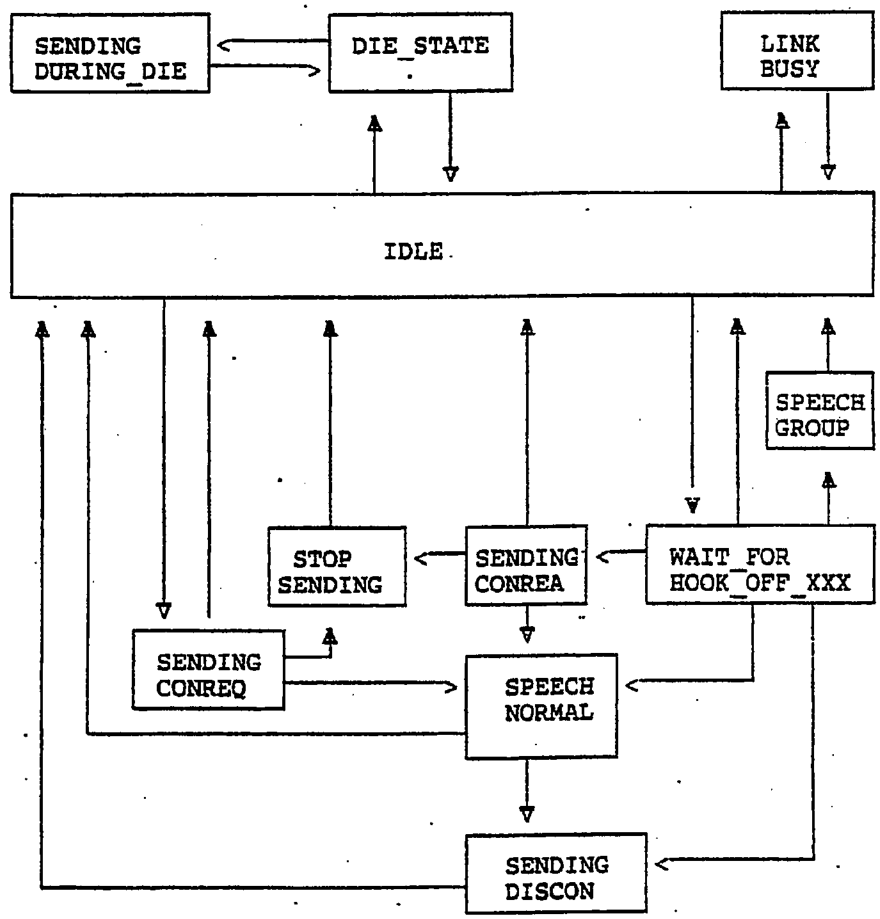
1.3 RETURNED MPAK WITH CODE

CODE	MEANING
SENT	This MPAK has been correctly sent by the data link layer.
NOT_SENT	This MPAK has not been correctly sent by the data link layer.
NOT_SENT_SPEECH	This MPAK has not been sent because of speech state in the network layer.
NOT_SENT_DIE	This MPAK has not been sent because of die state in the network layer.
NOT_SENT_BUFFER_FULL	This MPAK has not been sent because of buffer_full state in the network layer.
INCORRECT	Received MPAK from the application layer, do not have a correct format or is not allowed to be sent.
PERSONAL_MAN_EXIST	Present personal subscription MAN already exist in the flexlist.
PERSONAL_MAN_NOT_EXIST	Present personal subscription MAN does not exist in the flexlist.
FLEXLIST_FULL	The maximum number of MAN in the flexlist is exceeded.

1.4 STATES

idle	Idle state
die_state	A received MPAK:DIE has ordered the mobile to this state. No outgoing user traffic is allowed. A received MPAK:LIVE orders the mobile to idle state.
sending_during_die	Only MPAK of class DTESERV and MPAK:DISCON (CSUBCOM) can be sent during die_state.
link_busy	The data link layer can only handle one packet at a time. In the present state, the data link layer is busy.
sending_conreq	The data link layer is busy sending speech request.
stop_sending	The network layer has ordered the data link layer to stop sending present packet. The network layer is waiting until the data link layer is ready.
wait_for_hook_off_normal	A normal speech request is received and the network layer is waiting for response from the application layer.
wait_for_hook_off_fast	A fast speech request is received and the network layer is waiting for response from the application layer.
wait_for_hook_off_group	A group speech request is received and the network layer is waiting for response from the application layer.
sending_conrea	The data link layer is busy sending a hook_off signal (MPAK:CONREA).
speech_normal	The network layer is in speech state.
speech_group	The network layer is in group speech state.
sending_discon	The data link layer is busy sending a hook_on signal(MPAK:DISCON).

1.5 STATE DIAGRAM



WAIT_FOR_HOOK_OFF_XXX can be in three different states depending on the received speech request, as follows:

STATE	WHEN RECEIVING
WAIT_FOR_HOOK_OFF_NORMAL	CONREQ, ADDCONREQ, SOSCONREQ or EXTCONREQ
WAIT_FOR_HOOK_OFF_FAST	CONFAST, ADDCONFAST or SOSCONFAST
WAIT_FOR_HOOK_OFF_GROUP	CONORD

1.6 QUEUE HANDLING

```
   input queue:

  2 [          ]
  1 [          ]
                    <--------   input_queue_pointer
Input_signal:

  3 [          ]
  2 [          ]
                    <--------   input_queue_pointer+1
  1 [          ]
                    -------->   signal available for user
Save_signal:

  3 [          ]
  2 [          ]
                    <--------   input_queue_pointer+1
  1 [          ]
                    <--------   save_input_queue_pointer
Input_signal and save_signal:

  3 [          ]
                    <--------   input_queue_pointer+2
  2 [          ]
                    <--------   save_input_queue_pointer+1
  1 [          ]
                    <--------   save_input_queue_pointer
Input_signal :

  4 [          ]
                    <--------   input_queue_pointer+3
  3 [          ]
                    -------->   signal available for user
  2 [          ]
                    <--------   save_input_queue_pointer+1
  1 [          ]
                    <--------   save_input_queue_pointer
Input_signal :

  4 [          ]
  2 [          ]
                    <--------   input_queue_pointer+1
  1 [          ]
                    -------->   signal available for user
```

2 LOGICAL DESCRIPTION

2.1 Start of program

This program have two different modes, MOBITEX mode and MANUAL mode. In MANUAL mode, the network layer is stopped.
When MOBITEX mode is activated from MANUAL mode the network layer should be restarted.

```
NETWORK_LAYER
  P_activation_handling
  next_state = idle
  emergency_flag = FALSE
  IF permanent_list is not correct THEN
     make MPAK BORN
     send MPAK_to_transmit to LINK
     next_state = link_busy
     reset grouplist and flexlist
     set NOT grouplist_received_flag
  ENDIF
  LOOP
     IF manual_mode  THEN
        MOBITEX_network_layer inactivated
        activated = FALSE
        handle manual mode
     ELSE
        wait for input_signal
        IF emergency_flag THEN
           P_look_for_emergency
        ENDIF
        CASE signal

        WHEN MPAK_to_transmit from APP
           P_MPAK_FROM_APP

        WHEN MPAK_to_retransmit from APP
           P_MPAK_TO_RETRANSMIT

        WHEN MPAK_received from LINK
           P_REC_MPAK_FROM_LINK

        WHEN MPAK_transmitted from LINK
           P_MPAK_TRANSMITTED

        WHEN MPAK_not_transmitted from LINK
           P_MPAK_NOT_TRANSMITTED

        WHEN hook_on from APP
           P_HOOK_ON_handling

        WHEN hook_off from APP
           P_HOOK_OFF_handling

        WHEN hook_off_timeout
```

```
         P_timeout_handling

      WHEN roaming from LINK
         P_roaming_handling

      WHEN activation from LINK
         P_activation_handling_link

      WHEN activation_timeout
         P_activation_timeout_handling

      WHEN power_off from APP
         P_power_off_handling

      WHEN manual_mode_on
         P_manual_mode_on_handling

      WHEN power_off_timeout
         set power_off_ready

      WHEN manual_mode_on_timeout
         set manual_mode

      WHEN buffer_full
         P_buffer_full_handling

      ENDCASE
    ENDIF
  ENDLOOP
END_NETWORK_LAYER
```

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2.1.1 P_LOOK_FOR_EMERGENCY

```
P_look_for_emergency

  emergency_signal = FALSE

  WHILE NOT emergency_signal THEN

     CASE MPAK.type

        WHEN  SOS,SOSINFO,SOSACK,SOSCONREQ,SOSCONFAST
              emergency_signal = TRUE

        WHEN  OTHERWISE
              save_signal
              input_signal

     ENDCASE

  ENDWHILE

END_P_look_for_emergency
```

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2.2 P_MPAK_FROM_APP

```
P_MPAK_FROM_APP
  IF NOT buffer_full_flag THEN
     CASE next_state

     WHEN idle
           CASE MPAK.class
           WHEN PSUBCOM,PSOSCOM
              P_check_format
              IF format = true THEN
                 send MPAK_to_transmit to LINK
                 next_state = LINK_BUSY
              ELSE
                 send returned_MPAK_with_code:INCORRECT to APP
              ENDIF
           WHEN CSUBCOM
              P_check_format
              IF format = true THEN
                 P_check_and_send_CSUBCOM
              ELSE
                 send returned_MPAK_with_code:INCORRECT to APP
              ENDIF
           WHEN DTESERV
              P_check_format
              IF format = true THEN
                 P_check_and_send_DTESERV
              ELSE
                 send returned_MPAK_with_code:INCORRECT to APP
              ENDIF
           ENDCASE
     WHEN die_state
           IF MPAK.class = DTESERV  THEN
              P_check_format
              IF format = true THEN
                 P_check_and_send_DTESERV
              ELSE
                 send returned_MPAK_with_code:INCORRECT to APP
              ENDIF
           ELSE
              send returned_MPAK_with_code:NOT_SENT_DIE
           ENDIF
     WHEN  wait_for_hook_off_normal,
           wait_for_hook_off_fast,
           wait_for_hook_off_group
           IF MPAK.class = CSUBCOM THEN
              P_check_format
              IF format = true THEN
                 CASE MPAK.type
                 WHEN CONREA
                    P_hook_off_handling
                 WHEN DISCON
                    P_hook_on_handling
                 WHEN OTHERWISE
```

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```
            send  returned_MPAK_with_code:NOT_SENT_SPEECH
         ENDCASE
      ELSE
         send returned_MPAK_with_code:INCORRECT to APP
      ENDIF
   ELSE
      IF MPAK.class = PSOSCOM THEN
         save_signal
         make_hook_on signal
         P_HOOK_ON_handling
      ELSE
      send returned_MPAK_with_code:NOT_SENT_SPEECH to APP
      ENDIF
   ENDIF
WHEN  sending_conreq,sending_conrea,speech_normal,speech_group
   IF MPAK.class = CSUBCOM THEN
      P_check_format
      IF format = true THEN
         CASE MPAK.type
         WHEN DISCON
            P_hook_on_handling
         WHEN OTHERWISE
            send returned_MPAK_with_code:NOT_SENT_SPEECH
         ENDCASE
      ELSE
         send returned_MPAK_with_code:INCORRECT to APP
      ENDIF
   ELSE
      IF MPAK.class = PSOSCOM THEN
         CASE next_state
         WHEN sending_conreq,sending_conrea
            save_signal
            send order_to_return_MPAK to LINK
            next_state = stop_sending
         WHEN speech_normal,speech_group
            save_signal
            make_hook_on signal
            P_HOOK_ON_handling
         ENDCASE
      ELSE
         send returned_MPAK_with_code:NOT_SENT_SPEECH
      ENDIF
   ENDIF
WHEN OTHERWISE
      save_signal
ENDCASE
ELSE
   CASE MPAK.class
   WHEN PSUBCOM,PSOSCOM
      P_check_format
      IF format = true THEN
         send MPAK_to_transmit to LINK
         next_state = LINK_BUSY
      ELSE
         send returned_MPAK_with_code:INCORRECT to APP
      ENDIF
```

```
    WHEN OTHERWISE
      send returned_MPAK_with_code:NOT_SENT_BUFFER_FULL
    ENDCASE
  ENDIF
END_P_MPAK_FROM_APP
```

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2.2.1 F_CHECK_FORMAT

F_check_format

This routine checks and completes the format of this MPAK to be correct according to R1-09 Appendix A.
A correct MPAK will be returned with format = TRUE.
An incorrect MPAK will be returned with format = FALSE.

END_F_check_format

2.2.2 P_CHECK_AND_SEND_DTESERV

```
P_check_and_send_DTESERV
  CASE MPAK.type

  WHEN LOGINREQ
     IF  MPAK.type_dependent in our flexlist  THEN
        send returned_MPAK_with_code:PERSONAL_MAN_EXIST to APP
     ELSE
        IF more space in our flexlist
           MPAK.sender = MCU_MAN
           send MPAK_to_transmit to LINK
           next_state = LINK_BUSY
        ELSE
           send returned_MPAK_with_code:FLEXLIST_FULL
        ENDIF
     ENDIF

  WHEN VICESOSRX,SOSRX
     IF MPAK.sender in our flexlist THEN
           send MPAK_to_transmit to LINK
           next_state = LINK_BUSY
     ELSE
           send returned_MPAK_with_code:PERSONAL_MAN_NOT_EXIST to
                                                             APP
     ENDIF

  WHEN LOGOUT
           remove MPAK.sender from our flexlist
           MPAK.type_dependent = MCU_MAN
           send MPAK_to_transmit to LINK
           next_state = LINK_BUSY

  WHEN ACTIVE,INACTIVE
     send MPAK_to_transmit to LINK
     next_state = LINK_BUSY

  WHEN OTHERWISE
     send returned_MPAK_with_code:INCORRECT to APP

  ENDCASE
END_P_check_and_send_DTESERV
```

2.2.3 P_CHECK_AND_SEND_CSUBCOM

```
P_check_and_send_CSUBCOM
  CASE  MPAK.type
  WHEN  CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ,
        CONFAST,ADDCONFAST,SOSCONFAST
           MPAK.line = 0
           MPAK.connection_identity = next MPAK.connection_identity
           SPEECH_REG.part_here = MPAK.sender
           SPEECH_REG.other_part = MPAK.addressee
           SPEECH_REG.line = MPAK.line
           SPEECH_REG.conn_id = MPAK.connection_identity
           send MPAK_to_transmit to LINK
           next_state = sending_conreq

  WHEN DISCON

           send MPAK DISCON with
                 MPAK.sender = SPEECH_REG.part_here
                 MPAK.addressee = SPEECH_REG.other_part
                 MPAK.line = SPEECH_REG.line
                 MPAK.connection_identity = SPEECH_REG.conn_id
           send MPAK_to_transmit to LINK
           next_state = sending_discon

  WHEN OTHERWISE
           ignore_signal

  ENDCASE

END_P_check_and_send_CSUBCOM
```

2.3 P_MPAK_TO_RETRANSMIT

```
P_MPAK_to_retransmit

      CASE next_state
      WHEN idle
            CASE MPAK.class
            WHEN PSUBCOM,PSOSCOM
               P_check_format
               IF format = true THEN
                  send MPAK_to_retransmit to LINK
                  next_state = LINK_BUSY
               ELSE
                  send returned_MPAK_with_code:INCORRECT to APP
               ENDIF
            WHEN OTHERWISE
               send returned_MPAK_with_code:INCORRECT to APP
            ENDCASE
      WHEN die_state
            send returned_MPAK_with_code:NOT_SENT_DIE
      WHEN  wait_for_hook_off_normal,
            wait_for_hook_off_fast,
            wait_for_hook_off_group
            IF MPAK.class = PSOSCOM THEN
               save_signal
               make_hook_on signal
               P_HOOK_ON_handling
            ELSE
               send returned_MPAK_with_code:NOT_SENT_SPEECH to APP
            ENDIF
      WHEN  sending_conreq,sending_conrea,speech_normal,speech_group
            IF MPAK.class = PSOSCOM THEN
               CASE next_state
               WHEN sending_conreq,sending_conrea
                  save_signal
                  send order_to_return_MPAK to LINK
                  next_state = stop_sending
               WHEN speech_normal,speech_group
                  save_signal
                  make_hook_on signal
                  P_HOOK_ON_handling
               ENDCASE
            ELSE
               send returned_MPAK_with_code:NOT_SENT_SPEECH
            ENDIF
      WHEN OTHERWISE
            save_signal
      ENDCASE
END_P_MPAK_to_retransmit
```

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2.4 P_REC_MPAK_FROM_LINK

```
P_REC_MPAK_FROM_LINK

  activated = TRUE
  CASE MPAK.class
  WHEN PSUBCOM,PSOSCOM
     IF F_get_rec_man = MCU_MAN or in flexlist or in grouplist THEN
        send MPAK_received to APP
     ELSE
        P_unknown_handling_normal
     ENDIF
  WHEN CSUBCOM
     P_REC_MPAK_CSUBCOM_FROM_LINK
  WHEN DTESERV
     IF F_get_rec_man = MCU_MAN or in flexlist or in grouplist THEN
        CASE MPAK.state
        WHEN ok,from_mail
              P_REC_MPAK_DTESERV_FROM_LINK_NORMAL
        WHEN OTHERWISE
              CASE  MPAK.type
              WHEN  LOGINREQ,SOSRX,VICESOSRX
                 send MPAK_received to APP
              WHEN  OTHERWISE
                 ignore signal
              ENDCASE
        ENDCASE
     ELSE
        P_unknown_handling_normal
     ENDIF
  ENDCASE
END_P_REC_MPAK_FROM_LINK
```

2.4.1 P_UNKNOWN_HANDLING_NORMAL

```
P_unknown_handling_normal
  CASE next_state
  WHEN idle
        set MPAK.UNKNOWN_F = 1
        send MPAK_to_transmit to LINK
        next_state = link_busy
  WHEN die_state
        set MPAK.UNKNOWN_F = 1
        send MPAK_to_transmit to LINK
        next_state = sending_during_die
  WHEN OTHERWISE
     save_signal
  ENDCASE
END_P_unknown_handling_normal
```

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2.4.2 P_REC_MPAK_DTESERV_FROM_LINK_NORMAL

```
P_REC_MPAK_DTESERV_FROM_LINK_NORMAL
     CASE MPAK.type
     WHEN LOGINGRA
        Add personal subscription MAN to the flexlist
        send MPAK_received to APP
     WHEN LOGINREF
        send MPAK_received to APP
     WHEN LOGOUTORD
        remove personal subscription MAN from the flexlist
        send MPAK_received to APP
     WHEN DIE
        IF next_state = idle or die_state THEN
           next_state = die_state
           send die to APP
        ELSE
           save_signal
        END
     WHEN LIVE
        IF next_state = idle or die_state THEN
           next_state = idle
           send live to APP
        ELSE
           save_signal
        END
     WHEN GROUPLIST
        replace grouplist
        set grouplist_received_flag
        send MPAK_received to APP
        send group list information to data link layer
     WHEN AREALIST
        send area list information to data link layer
```

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```
    WHEN ROAMORD,FLEXREQ,INFOREQ,ESNREQ
       IF next_state = idle or die_state THEN
          CASE MPAK.type
          WHEN ROAMORD   make MPAK.type ROAM
          WHEN FLEXREQ   make MPAK.type FLEXLIST
          WHEN INFOREQ   make MPAK.type INFO
          WHEN ESNREQ    make MPAK.type ESNINFO
          ENDCASE
          send MPAK_to_transmit to LINK
          CASE next_state
          WHEN idle      next_state = link_busy
          WHEN die_state next_state = sending_during_die
          ENDCASE
       ELSE
          save_signal
       ENDIF
    WHEN FLEXLIST
       replace flexlist
       send MPAK_received to APP
    WHEN TIME
       send MPAK_received to APP
    WHEN OTHERWISE
       ignore_signal
    ENDCASE MPAK
END_P_REC_MPAK_DTESERV_FROM_LINK_NORMAL
```

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2.4.2.1 F_GET_REC_MAN

```
F_get_rec_man
        CASE MPAK.state
        WHEN ok,from_mail
              F_get_rec_man = MPAK.addressee
        WHEN OTHERWISE
              F_get_rec_man = MPAK.sender
        ENDCASE MPAK.state
END_F_get_rec_man
```

2.4.3 P_REC_MPAK_CSUBCOM_FROM_LINK

```
P_REC_MPAK_CSUBCOM_FROM_LINK
     CASE next_state
     WHEN idle
           P_REC_MPAK_CSUBCOM_FROM_LINK_IDLE
     WHEN link_busy,sending_during_die,stop_sending
           save_signal
     WHEN die_state
           P_REC_MPAK_CSUBCOM_FROM_LINK_DIE
     WHEN wait_for_hook_off_normal,
          wait_for_hook_off_fast,
          wait_for_hook_off_group
           P_REC_MPAK_CSUBCOM_FROM_LINK_WAIT
     WHEN speech_normal,speech_group
           P_REC_MPAK_CSUBCOM_FROM_LINK_SPEECH
     WHEN sending_conreq
           CASE MPAK.type
           WHEN  CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ,
                 CONFAST,ADDCONFAST,SOSCONFAST,CONORD
                    save_signal
                    send order_to_return_MPAK to LINK
                    next_state = stop_sending
           WHEN OTHERWISE
                    ignore_signal
           ENDCASE MPAK
     WHEN sending_conrea
           IF MPAK.type DISCON THEN
              send MPAK_received to APP
              send order_to_return_MPAK to LINK
              next_state = stop_sending
           ELSE
              ignore_signal
              send order_to_return_MPAK to LINK
              next_state = stop_sending
           ENDIF
     WHEN sending_discon
           save_signal
           send order_to_return_MPAK to LINK
           next_state = stop_sending
     ENDCASE
END_P_REC_MPAK_CSUBCOM_FROM_LINK
```

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1990-02-23 A MTS09C.2

2.4.3.1 P_REC_MPAK_CSUBCOM_FROM_LINK_IDLE

```
P_REC_MPAK_CSUBCOM_FROM_LINK_IDLE
  CASE MPAK.type
  WHEN CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ
        CASE MPAK.state
        WHEN ok
           IF F_get_rec_man = MCU_MAN or in flexlist
              start 60 second timer for hook off
              SPEECH_REG.part_here = MPAK.addressee
              SPEECH_REG.other_part = MPAK.sender
              SPEECH_REG.line = MPAK.line
              SPEECH_REG.conn_id = MPAK.connection_identity
              send MPAK_received to APP
              next_state = wait_for_hook_off_normal
           ELSE
              P_unknown_handling_csubcom
           ENDIF
        WHEN OTHERWISE
              send speech_off to LINK
        ENDCASE MPAK.state
  WHEN CONFAST,ADDCONFAST,SOSCONFAST
        CASE MPAK.state
        WHEN ok
           IF F_get_rec_man = MCU_MAN or in flexlist
              start 10 second timer for hook off
              SPEECH_REG.part_here = MPAK.addressee
              SPEECH_REG.other_part = MPAK.sender
              SPEECH_REG.line = MPAK.line
              SPEECH_REG.conn_id = MPAK.connection_identity
              send MPAK_received to APP
              next_state = wait_for_hook_off_fast
              send speech_on to LINK
           ELSE
              P_unknown_handling_csubcom
           ENDIF
        WHEN OTHERWISE
              send speech_off to LINK
        ENDCASE MPAK.state
  WHEN CONORD
        CASE MPAK.state
        WHEN ok
           IF F_get_rec_man in grouplist
              start 60 second timer for hook off
              send MPAK_received to APP
              next_state = wait_for_hook_off_group
              send speech_on to LINK
           ELSE
              send speech_off to LINK
           ENDIF
        WHEN OTHERWISE
              send speech_off to LINK
        ENDCASE MPAK.state
```

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```
  WHEN OTHERWISE
        send speech_off to LINK
  ENDCASE MPAK
END_P_REC_MPAK_CSUBCOM_FROM_LINK_IDLE
```

2.4.3.2 P_UNKNOWN_HANDLING_CSUBCOM

```
P_unknown_handling_csubcom
     send speech_on to LINK
     make MPAK DISCON with
           MPAK.sender = received_MPAK.addressee
           MPAK.addressee = received_MPAK.sender
           MPAK.line = received_MPAK.line
           MPAK.connection_identity =
                       received_MPAK.connection_identity
           MPAK.UNKNOWN_F= 1
     send MPAK_to_transmit to LINK
     next_state = sending_discon
END_P_unknown_handling_csubcom
```

2.4.3.3 P_REC_MPAK_CSUBCOM_FROM_LINK_DIE

```
P_REC_MPAK_CSUBCOM_FROM_LINK_DIE
  CASE MPAK.type
  WHEN  CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ,
        CONFAST,ADDCONFAST,SOSCONFAST
           CASE MPAK.state
           WHEN ok
              send speech_on to LINK
              make MPAK DISCON with
                    MPAK.sender = received_MPAK.addressee
                    MPAK.addressee = received_MPAK.sender
                    MPAK.line = received_MPAK.line
                    MPAK.connection_identity =
                            received_MPAK.connection_identity
              IF F_get_rec_man = MCU_MAN or in flexlist
                 send MPAK_to_transmit to LINK
              ELSE
                 set UNKNOWN_F = 1 in MPAK DISCON
                 send MPAK_to_transmit to LINK
              ENDIF
              next_state = sending_during_die
           WHEN OTHERWISE
                 send speech_off to LINK
           ENDCASE MPAK.state
  WHEN OTHERWISE
           send speech_off to LINK
END_P_REC_MPAK_CSUBCOM_FROM_LINK_DIE
```

2.4.3.4 P_REC_MPAK_CSUBCOM_FROM_LINK_WAIT

```
P_REC_MPAK_CSUBCOM_FROM_LINK_WAIT
  CASE MPAK.type
  WHEN DISCON
        reset hook_off timeout
        send speech_off to LINK
        send MPAK_received to APP
        next_state = idle
  WHEN CONORD
        ignore_signal
        IF next_state < > wait_for_hook_off_group THEN
              reset hook off timeout
              send speech_off to LINK
              next_state = idle
              make MPAK DISCON
              send MPAK_received to APP
        ENDIF
  ENDCASE

END_P_REC_MPAK_CSUBCOM_FROM_LINK_WAIT
```

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2.4.3.5 P_REC_MPAK_CSUBCOM_FROM_LINK_SPEECH

```
P_REC_MPAK_CSUBCOM_FROM_LINK_SPEECH
  CASE MPAK.type
  WHEN  CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ,
        CONFAST,ADDCONFAST,SOSCONFAST
           CASE MPAK.state
           WHEN no_transfer,illegal,congest,error,busy
              send speech_off to LINK
              send MPAK_received to APP
              next_state = idle
           WHEN OTHERWISE
              ignore_signal
              make MPAK DISCON
              send MPAK_received to APP
              send speech_off to LINK
              next_state = idle
           ENDCASE MPAK.state
  WHEN DISCON
           send MPAK_received to APP
           send speech_off to LINK
           next_state = idle
  WHEN CONORD
           ignore_signal
           IF next_state < > speech_group THEN
                 make MPAK DISCON
                 send MPAK_received to APP
                 send speech_off to LINK
                 next_state = idle
           ENDIF
  WHEN OTHERWISE
        ignore_signal
        make MPAK DISCON
        send MPAK_received to APP
        send speech_off to LINK
        next_state = idle
  ENDCASE
END_P_REC_MPAK_CSUBCOM_FROM_LINK_SPEECH
```

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2.5 P_MPAK_TRANSMITTED

```
P_MPAK_TRANSMITTED
  activated = TRUE
  CASE MPAK.class
  WHEN PSUBCOM,PSOSCOM,DTESERV
        CASE next_state
        WHEN link_busy
           next_state = idle
        WHEN sending_during_die
           next_state = die_state
        ENDCASE
        IF MPAK.UNKNOWN_F = 0 THEN
           IF MPAK.class = DTESERV THEN
              CASE MPAK.type
              WHEN LOGINREQ,SOSRX,VICESOSRX
                 send returned_MPAK_with_code:SENT to APP
              WHEN INACTIVE
                 IF power_off THEN
                    set power_off_ready
                 ENDIF
                 IF manual_mode_on received THEN
                    set manual_mode
                 ENDIF
              ENDCASE
           ELSE
              send returned_MPAK_with_code:SENT to APP
              IF (MPAK.class = PSUBCOM) AND (buffer_full_flag) THEN
                 make MPAK INACTIVE
                 send MPAK_to_transmit to LINK
                 next_state = link_busy
              ENDIF MPAK.class
           ENDIF MPAK.class
        ENDIF MPAK.UNKNOWN_F
  WHEN CSUBCOM
        CASE MPAK.type
        WHEN  CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ,
              CONFAST,ADDCONFAST,SOSCONFAST
              send speech_on to LINK
              send returned_MPAK_with_code:SENT to APP
              next_state = speech_normal
        WHEN CONREA
              send speech_on to LINK
              send returned_MPAK_with_code:SENT to APP
              next_state = speech_normal
        WHEN DISCON
              send speech_off to LINK
              send returned_MPAK_with_code:SENT to APP
              IF next_state = sending_during_die THEN
                    next_state = die_state
              ELSE
                    next_state = idle
              ENDIF
     ENDCASE MPAK
  ENDCASE MPAK.class
END_P_MPAK_TRANSMITTED
```

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2.6 P_MPAK_NOT_TRANSMITTED

```
P_MPAK_NOT_TRANSMITTED
  CASE MPAK.class
  WHEN PSUBCOM,PSOSCOM,DTESERV
           CASE next_state
           WHEN link_busy
                 next_state = idle
           WHEN sending_during_die
                 next_state = die_state
           WHEN stop_sending
                 next_state = idle
           ENDCASE
           IF MPAK.UNKNOWN_F = 0 THEN
              IF MPAK.class = DTESERV THEN
                    CASE MPAK.type
                    WHEN LOGINREQ,SOSRX,VICESOSRX
                       send returned_MPAK_with_code:NOT_SENT to APP
                    WHEN INACTIVE
                       IF power_off THEN
                          set power_off_ready
                       ENDIF
                       IF manual_mode_on received THEN
                          set manual_mode
                       ENDIF
                    ENDCASE
              ELSE
                 send returned_MPAK_with_code:NOT_SENT to APP
              ENDIF MPAK.class
           ENDIF MPAK.UNKNOWN_F
  WHEN CSUBCOM
     CASE MPAK.type
     WHEN   CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ,
            CONFAST,ADDCONFAST,SOSCONFAST
              IF  next_state = sending_conreq  THEN
                    send speech_off to LINK
              ENDIF
              next_state = idle
     WHEN CONREA
              send speech_off to LINK
              next_state = idle
     WHEN DISCON
              send speech_off to LINK
              IF next_state = sending_during_die THEN
                    next_state = die_state
              ELSE
                    next_state = idle
              ENDIF
     ENDCASE MPAK
     send returned_MPAK_with_code:NOT_SENT to APP
  ENDCASE MPAK.class
END_P_MPAK_NOT_TRANSMITTED
```

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2.7 P_HOOK_ON_HANDLING

```
P_HOOK_ON_handling
  CASE next_state
  WHEN  wait_for_hook_off_normal,
        wait_for_hook_off_fast,
        wait_for_hook_off_group
              reset hook_off timeout
              P_timeout_handling

  WHEN sending_conreq,sending_conrea
              save_signal
              send order_to_return MPAK to LINK
              next_state = stop_sending

  WHEN speech_normal
              make MPAK DISCON with
                    MPAK.sender = SPEECH_REG.part_here
                    MPAK.addressee = SPEECH_REG.other_part
                    MPAK.line = SPEECH_REG.line
                    MPAK.connection_identity = SPEECH_REG.conn_id
              send MPAK_to_transmit to LINK
              next_state = sending_discon

  WHEN speech_group
              send speech_off to LINK
              next_state = idle

  WHEN idle
              IF line connection request received THEN
                 make MPAK DISCON with
                    MPAK.sender = SPEECH_REG.part_here
                    MPAK.addressee = SPEECH_REG.other_part
                    MPAK.line = SPEECH_REG.line
                    MPAK.connection_identity = SPEECH_REG.conn_id
                 send MPAK_to_transmit to LINK
                 next_state = sending_discon
              ELSE
                 ignore_signal
              ENDIF
  WHEN OTHERWISE
              ignore_signal
  ENDCASE next_state
END_P_HOOK_ON_handling
```

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2.8 P_TIMEOUT_HANDLING

```
P_timeout_handling
  CASE next_state
  WHEN wait_for_hook_off_normal,wait_for_hook_off_fast
        send speech_on to LINK
        make MPAK DISCON with
                 MPAK.sender = SPEECH_REG.part_here
                 MPAK.addressee = SPEECH_REG.other_part
                 MPAK.line = SPEECH_REG.line
                 MPAK.connection_identity = SPEECH_REG.conn_id
        send MPAK_to_transmit to LINK
        next_state = sending_discon

  WHEN wait_for_hook_off_group
        send speech_off to LINK
        next_state = idle

  WHEN OTHERWISE
        ignore_signal
  ENDCASE next_state
END_P_timeout_handling
```

2.9 P_HOOK_OFF_HANDLING

```
P_HOOK_OFF_handling
  CASE next_state
  WHEN wait_for_hook_off_normal
        reset hook_off timeout
        make MPAK CONREA with
                 MPAK.sender = SPEECH_REG.part_here
                 MPAK.addressee = SPEECH_REG.other_part
                 MPAK.line = SPEECH_REG.line
                 MPAK.connection_identity = SPEECH_REG.conn_id
        send MPAK_to_transmit to LINK
        next_state = sending_conrea

  WHEN wait_for_hook_off_fast
        reset hook_off timeout
        next_state = speech_normal

  WHEN wait_for_hook_off_group
        reset hook_off timeout
        next_state = speech_group


  WHEN OTHERWISE
        ignore_signal
  ENDCASE next_state
END_P_HOOK_OFF_handling
```

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2.10 P_ROAMING_HANDLING

```
P_roaming_handling
  IF  next_state = idle or die_state  THEN
     IF  grouplist_received_flag  THEN
        make MPAK ROAM
     ELSE
        make MPAK BORN
     ENDIF
     send MPAK_to_transmit to LINK
     CASE next_state
     WHEN idle
        next_state = link_busy
     WHEN die_state
        next_state = sending_during_die
     ENDCASE
  ELSE
     save_signal
  ENDIF
END_P_roaming_handling
```

2.11 P_ACTIVATION_HANDLING

```
P_activation_handling
  IF NOT  buffer_full_flag THEN
     activated = FALSE
     start activation timer with 'active_delay_power_on'
  ENDIF
END_P_activation_handling
```

2.12 P_ACTIVATION_HANDLING_LINK

```
P_activation_handling_link
  IF NOT  buffer_full_flag THEN
     activated = FALSE
     start activation timer with 'active_delay_lost_contact'
  ENDIF
END_P_activation_handling_link
```

2.13 P_ACTIVATION_TIMEOUT_HANDLING

```
P_activation_timeout_handling
  IF  next_state = idle or die_state  THEN
     IF  NOT activated  THEN
        make MPAK ACTIVE
        send MPAK_to_transmit to LINK
        CASE next_state
        WHEN idle
           next_state = link_busy
        WHEN die_state
           next_state = sending_during_die
        ENDCASE
     ENDIF
  ELSE
        save_signal
  ENDIF
END_P_activation_timeout_handling
```

2.14 P_POWER_OFF_HANDLING

```
P_power_off_handling
  power_off_received
  start_power_off timer
  CASE next_state
  WHEN idle
     make MPAK INACTIVE
     send MPAK_to_transmit to LINK
     next_state = link_busy
  WHEN die_state
     make MPAK INACTIVE
     send MPAK_to_transmit to LINK
     next_state = sending_during_die
  WHEN speech_normal,speech_group,wait_for_hook_off_normal,
       wait_for_hook_off_fast,wait_for_hook_off_group,
       sending_conrea,sending_discon,sending_conreq
     disconnect the speech (according to current state)
     make MPAK INACTIVE
     send MPAK_to_transmit to LINK
     next_state = link_busy
  WHEN OTHERWISE
     save_signal
  ENDCASE
END_P_power_off_handling
```

2.15 P_MANUAL_MODE_ON_HANDLING

```
P_manual_mode_on_handling
  manual_mode_on received
  start manual_mode_on_timer
  CASE next_state
  WHEN idle
     make MPAK INACTIVE
     send MPAK_to_transmit to LINK
     next_state = link_busy
  WHEN die_state
     make MPAK INACTIVE
     send MPAK_to_transmit to LINK
     next_state = sending_during_die
  WHEN speech_normal,speech_group,wait_for_hook_off_normal,
       wait_for_hook_off_fast,wait_for_hook_off_group,
       sending_conrea,sending_discon,sending_conreq
     disconnect the speech (according to current state)
     make MPAK INACTIVE
     send MPAK_to_transmit to LINK
     next_state = link_busy
  WHEN OTHERWISE
     save_signal
  ENDCASE

END_P_manual_mode_on_handling
```

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2.16 P_BUFFER_FULL_HANDLING

```
P_buffer_full_handling
  CASE next_state
  WHEN idle
     make MPAK INACTIVE
     send MPAK_to_transmit to LINK
     next_state = link_busy
  WHEN die_state
     make MPAK INACTIVE
     send MPAK_to_transmit to LINK
     next_state = sending_during_die
  WHEN speech_normal,speech_group,wait_for_hook_off_normal,
       wait_for_hook_off_fast,wait_for_hook_off_group,
       sending_conrea,sending_discon,sending_conreq
     disconnect the speech (according to current state)
     make MPAK INACTIVE
     send MPAK_to_transmit to LINK
     next_state = link_busy
  WHEN OTHERWISE
     save_signal
  ENDCASE

  send buffer_full to APP
  set buffer_full_flag

END_P_buffer_full_handling
```

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	Datum Date 1990-02-23	Rev A	Fil File MTS09C.2

3 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 4, 6
R1-09, 7, 18

Below are the reference designations listed.

Reference	Section
R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05	References
R1-06.	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

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REQUIREMENT SPECIFICATION 1(9)

Uppgjord Prepared	Faktaansvarig Subject responsible	Nr No		
1988 ET/SYS PES	ET/SYS PES	6/1056 - A 296 5171 Ue		
Dokansv Godkänd - Doc respons/approved		Datum Date	Rev	Fil File
ET/SYSC STT STT		1990-02-26	E	MTS11HDLC.1

Benämning

Cantel Mobitex

Title

MOBITEX
HDLC interface
Fixed terminal

ABSTRACT

This document is a specification of the interface for a fixed terminal with HDLC interface, connected to the MOBITEX network.

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1990-02-26	E	MTS11HDLC.1

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1 INTRODUCTION

1.1 GENERAL

The designation "terminal" for a fixed terminal in the MOBITEX network corresponds to DTE in CCITT recommendations and secondary station in HDLC.

CCITT recommendation X.21 bis is used at the physical layer and HDLC is used at the link layer. The network layer consists of MPAK's according to reference R1-09.

2 PHYSICAL LAYER

2.1 GENERAL

Connection is in accordance with CCITT recommendation X.21 bis.

2.2 BITRATE

For information about permitted bitrate transmission rates, please refer to reference R1-06.

3 LINK LAYER

3.1 GENERAL

The design of the link layer follows ISO standards "High level data link control" (HDLC). See ISO 3309-1984, ISO 4335-1984 and ISO 7809-1984 for reference.

3.2 SUB-SET OF HDLC

HDLC is a comprehensive catalogue of standards for link control. The UNC 12 class, i.e. "Unbalanced operation, normal response mode" with added test function, of procedure is used for the link layer.

The MOBITEX network is the primary station and the fixed terminal is the secondary station.

3.2.1 Clarification

3.2.1.1 Commands and responses

The following commands and responses are obtained with the above class:

Command from network	Response from fixed terminal
I	I
RR RNR	RR RNR
SNRM DISC	UA DM FRMR
TEST	TEST

3.2.1.2 Frame size

A frame can be up to 566 octets including start and stop flag. This will allow 560 octets in an information field in an I frame.

3.2.1.3 The use of the address field

The address field comprises one octet. The address in the address field shall be adjustable. The factory set address shall be 11000000 (bit 1...8).

Address 11111111 is defined as the all-station address and thus all receiving data stations shall accept and action the associated frame. If the P bit is set in such a frame, the terminal shall reply with its own address as reply address.

3.2.1.4 FRMR responses

The information field in an FRMR response shall be padded with zeros so the length will be 3 octets.

3.2.1.5 TEST frames

TEST frames can contain an information field. The maximum length of that field is the same as for I-frames.

TEST frames can be transmitted and received both in NRM and NDM.

3.3 OPERATING MODES FOR THE LINK LAYER

The link layer shall be able to assume the following modes:

- o Normal resonse mode (NRM) according to ISO 4335 item 5.1.1.
- o Normal disconnected mode (NDM) according to ISO 4335 items 5.2 and 5.2.1.

A terminal's capacity in NDM is limited to:

- accepting the mode setting commands (SNRM or DISC)
- accepting and responding to a test command
- transmitting DM or TEST at a respond opportunity

A terminal may only change to NRM from NDM by accepting an SNRM command from the network.

A terminal can change from NRM to NDM by accepting a DISC command from the network or through manual restart of the link control. NDM shall be the initial mode when power is switched on or when restarting the terminal.

3.4 CONNECTION AND DISCONNECTION PROCEDURE

The link is connected in accordance with ISO 7809 item 3.4.1.1. The network transmits SNRM to the terminal. If there is no reply, the SNRM is retransmitted until an UA reply is received.

Normal disconnection of the link is in accordance with ISO 7808, item 3.4.1.2. If there is no reply from the terminal, DISC is retransmitted. This is repeated no more than 10 times or until an UA reply is received. The link is then assumed to be disconnected and the connection at the lower level can be broken.

If there are no frames to send, the link layer shall send flags continuosly as soon as the physical layer is in data transmission mode.

3.5 TIME-OUT

When the terminal receives a correct frame with the P bit set to "1" (one), the reply shall commence within 50 ms. The time is calculated from when the last bit of the command's closing flag is received until the first bit of the response is transmitted.

If several frames are transmitted in sequence, the time between them shall not exceed 50 ms. This time is calculated from the last bit of a frame's closing flag to the first bit of the next frame's opening flag.

The terminal has no time-out function for recovery in the event of a link fault. The terminal however may have time-out function to inform the operator about a link fault. The time-out may not be less than 45s in NRM and 120 s in NDM.

3.6 RECOVERY FROM FAULT CONDITION

All recovery from a fault condition is carried out by the network. The terminal is first ordered to NDM and then to NRM.

4 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 4
R1-09, 3

Below are the reference designations listed.

Reference	Section
R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05	References
R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

The following external references are made in this document:

CCITT recommendations series X, 1984 Edition (Red Book) X.21 bis

ISO-standards:

ISO 3309-1984(E)
ISO 4335-1984(E)
ISO 7809-1984(E)

Dokumentnamn
REQUIREMENT SPECIFICATION 1(11)

Uppgjord - Prepared	Faktaansvarig - Subject responsible	Nr - No	
1988 ET/SYS PES	ET/SYS PES	1056 - A 296 5491 Ue	
Dokansv Godkänd - Doc respons/approved		Datum - Date / Rev	Fil - File
ET/SYSC STT STT		1990-02-26 C	MTS11X25.1
Benämning		Titel	
Cantel Mobitex		MOBITEX X.25 interface Fixed terminal	

ABSTRACT

This document is a specification of the interface for a fixed terminal with X.25 interface, connected to the MOBITEX network.

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T A B L E O F C O N T E N T S

1 INTRODUCTION

1.1 GENERAL

The designation 'terminal' for a fixed terminal in the MOBITEX network corresponds to DTE in CCITT recommendations for X.25 packet layer and link layer.

Connection of a terminal with X.25-interface can be done directly to the MOBITEX network or through an X.25 network.

CCITT recommendation X.21 bis is used at the physical layer, LAPB is used at the link layer and X.25 is used at the packet layer.

The user data in X.25 packet layer should contain MPAKs as described in reference R1-09.

2 PHYSICAL LAYER

2.1 GENERAL

Connection is in accordance with CCITT recommendation X.21 bis.

2.2 BITRATE

For information about permitted bitrate transmission rates, please refer to reference R1-06.

3 LINK LAYER

The design of the link layer follows LAPB, Link Access Procedure Balanced, according to CCITT recommendation X.25.

The extended format modulo 128 is not supported.

The multilink procedure MLP is not supported.

Timeout period is T1=3 seconds.

Maximum number of outstanding frames are K=7.

Number of retransmission attempts are N2=10.

4 PACKET LAYER

The design of the packet layer follows CCITT recommendation X.25 for DTE with the following restrictions:

When the terminal is using direct connection there is only one logical channel. The logical channel group number should be zero and the logical channel number should be one.

When connection is made through an X.25 network, maximum number of logical channels are 8.

The delivery-bit should be set to zero in all data packets.

The qualifier-bit is ignored by the MOBITEX network.

The sequence numbering scheme of the data packets is performed modulo 8.

The standard default value for the window size is two packets. It is possible to change the default window size to 1, 3, 4, 5, 6 or 7 packets.

The standard default value for the packet size is 128 octets. It is possible to change the default packet size to 32, 64, 256, or 512 octets.

Interrupt, reject and registration packets are not supported.

The following facilities are supported:

- Flow control parameter negotiation.
- Non standard default packet size.
- Non standard default window size.
- Reverse charging. (See note 1.)
- Reverse charging acceptance. (See note 1.)

A connected terminal can communicate with MOBITEX through a permanent virtual circuit (PVC) or through a virtual circuit (VC).

If no packets, in either direction, has been transmitted on the logical channel during X (default 4 and possible to change) minutes a virtual call will be cleared by the MOBITEX network if the connection is VC.

Note 1 : Only used when connected through an X.25 network.

The packet call request/incoming call and call accepted/ call connected should contain both calling DTE address and called DTE address (optional in CCITT X.25).

4.1 Diagnostic codes

Coding of the restarting cause field and the diagnostic code field in a restart packet, used by the MOBITEX network and the connected terminal.

cause	diagn.	explanation
00		local procedure error
	17	invalid packet type for state r1
	52	time expired for restart indication
07		network operational

Coding of the clearing cause field and the diagnostic code field in a clear packet, used by the MOBITEX network and the connected terminal.

cause	diagn.	explanation
0		dte originated
	0	dte clearing
01		number busy
	72	call collision
03		invalid facility request
	65	facility code not allowed
	66	facility parameter not allowed
19		local procedure error
	20	invalid packet type for state p1
	21	invalid packet type for state p2
	22	invalid packet type for state p3
	24	invalid packet type for state p4
	26	invalid packet type for state p6
	33	unidentifiable packet
	38	packet too short
	41	restart with nonzero in bits 1-4 in octet 1 or nonzero in bits 1-8 in octet 2
	49	time expired for incoming call
	50	time expired for clear indication
	51	time expired for reset indication
	67	invalid called address
	68	invalid calling address
	69	invalid facility length

Coding of the resetting cause field and the diagnostic code field in a reset packet, used by the MOBITEX network and the connected terminal.

cause	diagn.	explanation
05		local procedure error
	01	invalid p(s)
	02	invalid p(r)
	27	invalid packet type for state d1
	32	packet type not allowed (registration or interrupt packet)
	35	invalid packet type on pvc channel
	37	reject packet not subscribed
	41	restart with nonzero in bits 1-4 in octet 1 or nonzero in bits 1-8 in octet 2
	51	time expired for reset indication

Coding of the diagnostic code field in a diagnostic packet, used by the MOBITEX network and the connected terminal.

diagn.	explanation
36	packet on unassigned logical channel
38	packet too short
40	invalid general format identifier
50	time expired for clear indication
51	time expired for reset indication
52	time expired for restart indication

5 MOBITEX NETWORK LAYER

The MPAK should be placed in the user data field in one or more X.25 data packets. An MPAK should be handled as a complete packet sequence, according to CCITT's X.25 recommendation # 4.3.5.
Note: The D-bit should always be set to zero in communication with the MOBITEX network.

If the transmission of an MPAK is interrupted by a restart, reset or clear procedure the whole MPAK should be retransmitted.

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6 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 4
R1-09, 3

Below are the reference designations listed.

Reference	Section
R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05	References
R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

The following external references are made in this document:

CCITT recommendations series X, 1984 edition (Red book) X.25 and X.21 bis

Dokumentnamn			Blad Sheet
		REQUIREMENT SPECIFICATION	1(17)
Uppgjord - Prepared: 1988 ET/SYS PES	Faktaansvarig Subject responsible: ET/SYS PES	Nr No: 1056 - A 296 5490 Ue	
Dokansv Godkänd - Doc respons/approved: ET/SYSC STT STT		Datum - Date: 1990-02-26 Rev: C	Fil File: MTS11BSC.1
Benämning: Cantel Mobitex		Title: MOBITEX BSC interface Fixed terminal	

ABSTRACT

This document is a specification of the interface for a fixed terminal with binary synchronous communication (BSC) interface, connected to the MOBITEX network.

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Cantel Mobitex

Nr No: 1056 - A 296 5490 Ue
Datum Date: 1990-02-26 | Rev: C | Fil File: MTS11BSC.1

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1 INTRODUCTION

1.1 GENERAL

The designation "terminal" for a fixed terminal in the MOBITEX network corresponds to DTE in CCITT recommendations.

CCITT recommendation X.21 bis is used at the physical layer. The link layer is IBM's BSC (binary synchronous communication), see chapter 2.

The network layer is a character oriented MPAK (BSCPAK), see chapter 4.

2 PHYSICAL LAYER

2.1 GENERAL

Connection is in accordance with CCITT recommendation X.21 bis.

2.2 BITRATE

For information about permitted bitrate transmission rates, please refer to reference R1-06.

3 LINK LAYER

The design of the link layer follows IBM General Information - Binary Synchronous Communications, GA27-3004 with the following restrictions:

Point-to-point connection is used. The Mobitex network has a retry timeout of 3 seconds.

ITB and RVI will be handled by the Mobitex network when received, but is never transmitted.

Transparent mode is not handled by the Mobitex network.

SOH can be received but the content of the header is not interpreted. SOH is never transmitted.

The Mobitex network retransmits max 15 times.

4 NETWORK LAYER

The network layer use BSCPAK. A BSCPAK is a character-oriented MPAK, MPAKs are bit-oriented and are described in reference R1-09.

BSCPAK is EBCDIC-coded, see chapter 6.

All MPAK, except MPAK DATA, HPDATA and EXTPAK can be translated to BSCPAK.

Sendlist is not handled.

All numeric fields are right adjusted with preceding zeroes.

BSCPAK shall be handled in the same way as corresponding MPAK.

Maximum length for a BSCPAK is 548 octets (BSCPAK TEXT without sendlist).

A BSCPAK may be divided into several blocks, each of which ends with ETB except the last one which ends with ETX.

The content of the text field in a BSC-block is a BSCPAK (or part of BSCPAK) in either direction, to or from the Mobitex network.

STX precedes and ETX ends a BSCPAK.

5 SPECIFICATION OF BSCPAK

BSCPAK shall be handled, according to reference R1-09, in the same way as corresponding MPAK. Below is a description of the translation between bit-oriented MPAK and the character oriented BSCPAK.

All BSCPAKs consist of one BSCPAK header and one part with typedependent components.

All characters in a BSCPAK shall be in EBCDIC code.

5.1 BSCPAK, COMMON COMPONENTS

BSCPAK-field	octet	comment
sender	1- 8	only digits
adressee	9-16	only digits
class	17	only digits
extern_F	18	0 or 1
type	19-20	only digits
mailbox_F	21	0 or 1
digital_F	22	0 or 1
sendlist_F	23	0
unknown_F	24	0 or 1 (0 from Mobitex)
reserve_F	25	0
trafstate	26	0 ... 7 (0 to Mobitex)

Length 26 octets.

Ex. sender = 123456

octet 1	0
	0
	1
	2
	3
	4
	5
octet 8	6

Octet 1 will be transmitted first.

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5.2 BSCPAK COMPONENTS

The following components are described in this chapter:

TEXT
STATUS
SOSINFO
SOSACK
CONREQ
SOSCONREQ
ADDCONREQ
CONGRA
CONORD
CONREA
DISCON
EXTCONREQ
CLOOPON
CLOOPOFF
LOGINREQ
LOGINGRA
LOGINREF
LOGOUT
LOGOUTORD
ACTIVE
INACTIVE
DIE
LIVE
VICESOSRX
SOSRX
GROUPLIST
FLEXREQ
FLEXLIST
TIME

* TEXT without adress list:

BSCPAK-field	octet	comment
bscpak-header	1-26	
time	27-36	decimal digits (YYMMDDHHMM)
text	37-	all characters included in Mobitex textcode (EBCDIC-coded), 1-512 characters

Length 37-548 octets.

* STATUS without adress list:

BSCPAK-field	octet	comment
bscpak-header	1-26	
time	27-36	decimal digits (YYMMDDHHMM)
status code	37-39	only digits 000 ... 255

Length 39 octets.

* SOSINFO

BSCPAK-field	octet	comment
bscpak-header	1-26	
time	27-36	decimal digits (YYMMDDHHMM)
static emergency information	37-	all characters included in Mobitex textcode (EBCDIC-coded), 0-256 characters
dynamic emergency information	37-	all characters included in Mobitex textcode (EBCDIC-coded), 0-256 characters

Length 36-548 octets.

* SOSACK

BSCPAK-field	octet	comment
bscpak-header	1-26	
time	27-36	decimal digits (YYMMDDHHMM)
emergency acknowledgement status	37-39	decimal digits 000..255

Length 39 octets.

* CONREQ

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255

Length 32 octets.

* SOSCONREQ

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255

Length 32 octets.

* ADDCONREQ

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255
additional information	33-52	all characters included in Mobitex textcode (EBCDIC-coded)

Length 52 octets.

* CONGRA

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255

Length 32 octets.

* CONORD

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255

Length 32 octets.

* CONREA

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255

Length 32 octets.

* DISCON

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255

Length 32 octets.

* EXTCONREQ

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255
subscr. no. in ext. network	33-52	decimal digits

Length 52 octets.

* CLOOPON

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)

Length 29 octets.

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Nr No		
1056 - A 296 5490 Ue		
Datum Date 1990-02-26	Rev C	Fil File MTS11BSC.1

* CLOOPOFF

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)

Length 29 octets.

* LOGINREQ

BSCPAK-field	octet	comment
bscpak-header	1-26	
MAN	27-34	only decimal digits
password	35-42	all characters included in Mobitex textcode (EBCDIC-coded)

Length 42 octets.

* LOGINGRA

BSCPAK-field	octet	comment
bscpak-header	1-26	
MAN	27-34	only decimal digits

Length 34 octets.

* LOGINREF

BSCPAK-field	octet	comment
bscpak-header	1-26	
MAN	27-34	only decimal digits

Length 34 octets.

* LOGOUT

BSCPAK-field	octet	comment
bscpak-header	1-26	
MAN	27-34	only decimal digits

Length 34 octets.

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* LOGOUTORD

BSCPAK-field	octet	comment
bscpak-header	1-26	
MAN	27-34	only decimal digits

Length 34 octets.

* ACTIVE

BSCPAK-field	octet	comment
bscpak-header	1-26	

Length 26 octets.

* INACTIVE

BSCPAK-field	octet	comment
bscpak-header	1-26	

Length 26 octets.

* DIE

BSCPAK-field	octet	comment
bscpak-header	1-26	

Length 26 octets.

* LIVE

BSCPAK-field	octet	comment
bscpak-header	1-26	

Length 26 octets.

* VICESOSRX

BSCPAK-field	octet	comment
bscpak-header	1-26	

Length 26 octets.

* SOSRX

BSCPAK-field	octet	comment
bscpak-header	1-26	

Length 26 octets.

* GROUPLIST

BSCPAK-field	octet	comment
bscpak-header	1-26	
number of MAN	27-28	1..15
MAN 1	29- 36	only decimal digits
MAN 2	37- 44	only decimal digits
MAN 3	45- 52	only decimal digits
MAN 4	53- 60	only decimal digits
MAN 5	61- 68	only decimal digits
MAN 6	69- 76	only decimal digits
MAN 7	77- 84	only decimal digits
MAN 8	85- 92	only decimal digits
MAN 9	93-100	only decimal digits
MAN 10	101-108	only decimal digits
MAN 11	109-116	only decimal digits
MAN 12	117-124	only decimal digits
MAN 13	125-132	only decimal digits
MAN 14	133-140	only decimal digits
MAN 15	141-148	only decimal digits

Length 148 octets.

* FLEXREQ

BSCPAK-field	octet	comment
bscpak-header	1-26	

Length 26 octets.

* FLEXLIST

BSCPAK-field	octet	comment
bscpak-header	1-26	
number of MAN	27	1..7
MAN 1	28-35	only decimal digits
MAN 2	36-43	only decimal digits
MAN 3	44-51	only decimal digits
MAN 4	52-59	only decimal digits
MAN 5	60-67	only decimal digits
MAN 6	68-75	only decimal digits
MAN 7	76-83	only decimal digits

Length 83 octets.

* TIME

BSCPAK-field	octet	comment
bscpak-header	1-26	
time	27-36	decimal digits (YYMMDDHHMM)

Length 36 octets.

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6 TRANSLATION BETWEEN ASCII AND EDCDIC

ASCII	EBCDIC
09	05
0A	25
0C	0C
0D	0D
20	40
21	5A
22	7F
23	7B
24	5B
25	6C
26	50
27	7D
28	4D
29	5D
2A	5C
2B	4E
2C	6B
2D	60
2E	4B
2F	61
30	F0
31	F1
32	F2
33	F3
34	F4
35	F5
36	F6
37	F7
38	F8
39	F9
3A	7A
3B	5E
3C	4C
3D	7E
3E	6E
3F	6F
40	7C
41	C1
42	C2
43	C3
44	C4
45	C5
46	C6
47	C7
48	C8
49	C9
4A	D1
4B	D2
4C	D3
4D	D4
4E	D5

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4F	D6
50	D7
51	D8
52	D9
53	E2
54	E3
55	E4
56	E5
57	E6
58	E7
59	E8
5A	E9
5B	4A
5C	E0
5D	4F
5E	5F
5F	6D
60	79
61	81
62	82
63	83
64	84
65	85
66	86
67	87
68	88
69	89
6A	91
6B	92
6C	93
6D	94
6E	95
6F	96
70	97
71	98
72	99
73	A2
74	A3
75	A4
76	A5
77	A6
78	A7
79	A8
7A	A9
7B	C0
7C	6A
7D	D0
7E	A1

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7 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 4
R1-09, 6, 7

Below are the reference designations listed.

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R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05	References
R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

The following references are made in this document:

CCITT recommendations series V, 1984 Edition(Red books)X.21 bis.

IBM General Information - Binary Synchronous Communications, GA27-3004.

Dokumentnamn REQUIREMENT SPECIFICATION				Blad Sheet 1(7)
Uppgjord - Prepared 1988 ET/SYS PES	Fackansvarig - Subject responsible ET/SYS PES	Nr No 1056 - A 296 5516 Ue		
Dokansv/Godkänd - Doc respons/approved ET/SYSC STT STT		Datum Date 1990-02-26	Rev D	Fil File MTS11MASC.1
Benämning Cantel Mobitex		Titel MOBITEX MASC interface Fixed terminal		

ABSTRACT

This document is a specification of the interface for a fixed terminal with MOBITEX Asynchronus Communication (MASC) interface, connected to the MOBITEX network.

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Cantel Mobitex	Nr No 1056 - A 296 5516 Ue	
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Cantel Mobitex™

Nr No		
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Datum Date 1990-02-26	Rev D	File MTS11MASC.1

1 INTRODUCTION

1.1 GENERAL

The designation "terminal" for a fixed terminal in the MOBITEX network correspond to DTE in CCITT recommendations.

CCITT recommendation V.24 is used at the physical layer and MASC interface is used at the link layer (reference R1-19 is used for link layer MASC). The network layer consists of MPAK's according to reference R1-09.

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2 PHYSICAL LAYER

2.1 GENERAL

Connection is in accordance with CCITT recommendation V.24/V.28.

Note: The physical layer of MASC is not directly compatible with the physical layer in the masc interface of a mobile terminal.

However this can be done by connecting the following signals in the mobile unit.

105
106
107
108/2
109

2.2 BITRATE

For information about permitted bitrate transmission rates, please see reference R1-06.

3 LINK LAYER

3.1 GENERAL

The link layer sends, controls and acknowledge information between network and terminal. When faults are detected, the link layer handles retransmission.

The design of the link layer follows PROTOCOL FOR MASC TYPE TERMINALS, which is described in reference R1-19.

The data in information frame is MOBITEX packets (MPAK) which are described in reference R1-09.

3.2 FRAMES USED IN MASC

There are two different types of frames, control frames and information frames (see reference R1-19).

The following control frames are used:

- ACK Acknowledgement
- NACK Negative acknowledgement
- RACK Request for repetition of the latest sent ACK
- SENS Communication link control
- SACK Acknowledgement of a received SENS

Note: The network will not send the frame SENS by default.

Information frames are used with the following commands:

- B parameters in machine interface
- M send/receive MPAK
- E answer to an invalid command
- F P terminal MAN request and answer
- F Q masc device identity

3.3 TIMEOUT

The masc interface uses two timers, which are described in reference R1-19.

Note: The network will handle the "30 seconds timeout" as follows:
If no answer is received within 30 seconds, the network will return the frame to the sender. The network will then try to start up the line with a B-command.

3.4 START WITH NO SUBSCRIPTION NUMBER

The terminal has the possibility to ask the network about the valid subscription number. When the line is in the connected mode, the terminal can ask the network about MOBITEX subscription number.

The terminal sends the F P command and receives the answer F PMAN from the network. The terminal will also receive an identification of the network in the F Q command.

The commands F P and F Q are described in reference R1-19.

4 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 4
R1-09, 3, 5
R1-19, 3, 5, 6

Below are the reference designations listed.

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R1-09	Network layer
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R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

The following external references are made in this document:

CCITT recommendations series V, 1984 Edition (Red books) V.24 and V.28

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REQUIREMENT SPECIFICATION 1(7)

Prepared	Subject responsible	No		
ET/SYS PES	ET/SYS PES	1056 - A 296 5454 Ue		
Document responsible/approved: ET/SYSC STT STT		Date: 1990-02-27	Rev: C	File: MTS11MPAD.1

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MOBITEX
Asynchronous interface
Fixed terminal MPAD

ABSTRACT

This document describes the connection of an asynchronous terminal to the MPAD service in the MOBITEX network.

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Cantel Mobitex™	1056 - A 296 5454 Ue	
	1990-02-27 C	MTS11MPAD.1

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1 INTRODUCTION

1.1 GENERAL

The MPAD communicates with the terminal one character at a time with a start-stop protocol. The purpose with the MPAD service is to let customers use a standard terminal for communication with the MOBITEX network.

The designation "terminal" for a fixed termial in the MOBITEX network corresponds to DTE in CCITT recommendations.

2 PHYSICAL LAYER

2.1 GENERAL

Connection is in accordance with CCITT recommendations V.24/V.28.

2.2 TERMINAL EQUIPMENT

An asynchronous terminal of start-stop type for serial data transmission is used. The communication uses 1 start bit, 8 data bits, 1 stop bit and no parity. The screen should be 24 lines x 80 columns. The terminal should have an advanced video option installed to use the reversed video facility.

If the MPAD-connected terminal has a printer port or auxiliary port, a printer can be connected to this port. Messages to/from the terminal can be directed to this printer if the terminal can interpret the printer-port setting commands described in chapter 3.

2.3 PRINTER EQUIPMENT (optional)

The printer should have at least 24 columns, preferably 80 columns width. The transmission rate and communication type depends on the available printer-port on the terminal. The printer should be able to use the same character-set as the terminal, see chapter 3.

2.4 BITRATE

For information about permitted transmission rates, please refer to reference R1-06.

3 PROTOCOL FOR TERMINAL

The terminal should comply with ANSI/VT100 according to the following specifications that is a subset of ANSI X3.41 1974 and ANSI X3.64 1979.

The terminal should be able to :

* transmit and receive all characters described in MOBITEX text code (please refer to reference R1-06).
* transmit ASCII-character 127 (DEL).
* receive ASCII-character 7 (bell) and then give an audible signal.
* receive ASCII-character 10 (LF) and then do a line-feed.
* receive ASCII-character 13 (CR) and then do a carriage return.
* generate the control sequences described in chapter 3.1
* interpret the control sequences described in chapter 3.2

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1990-02-27	C	MTS11MPAD.1

3.1 CONTROL SEQUENCES FROM TERMINAL TO MPAD

The following control sequences should preferably be generated by arrow-marked keys.

```
ESC O A         (arrow up)
ESC O B         (arrow down)
ESC O C         (arrow right)
ESC O D         (arrow left)
```

The following control sequences should preferably be generated by the keys on an auxiliary keypad.

```
ESC O p         (0)
ESC O q         (1)
ESC O r         (2)
ESC O s         (3)
ESC O t         (4)
ESC O u         (5)
ESC O v         (6)
ESC O w         (7)
ESC O x         (8)
ESC O y         (9)
ESC O m         (dash)
ESC O l (=lowercase L)(comma)
ESC O n         (period)
ESC O M         (ENTER)
ESC O P         (PF1)
ESC O Q         (PF2)
ESC O R         (PF3)
ESC O S         (PF4)
```

3.2 CONTROL SEQUENCES FROM MPAD TO TERMINAL

```
ESC =           Set terminal in keypad application mode
ESC 7           Save cursor
ESC 8           Restore cursor
ESC [ 7 m       Set reverse video
ESC [ 0 m       All video attributes off
ESC [ 5 i       Enter printer controller mode
ESC [ 4 i       Exit printer controller mode
ESC [ 0 k       Erase line after cursor
ESC E           Next line
ESC [ 20 h      Set new line mode
ESC [ x;y H     Move cursor to line x and column y
ESC [ ? 1 (=one) h        Set cursor key mode
ESC [ 2 J       Erase all of the display
```

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4 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

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R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

The following external references are made in this document:

CCITT recommendations series V, 1984 Edition (Red books) V.24 and V.28

ANSI X3.41 1974
ANSI X3.64 1979

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Dokumentnamn
REQUIREMENT SPECIFICATION 1(4)

Upprättad Prepared	Faktaansvarig Subject responsible	Nr - No		
1988 ET/SYS Pes	ET/SYS Pes	1056 - A 296 5176 Ue		
Dokansv.Godkänd Doc respons approved		Datum - Date	Rev	Fil File
ET/SYSC STT SII		1990-02-26	C	MTS12.1

Benämning

Cantel Mobitex

Title

MOBITEX
Other requirements,
Fixed terminals

ABSTRACT

This document specifies general requirements for fixed terminals, connected to the MOBITEX network.

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Cantel Mobitex™	Nr No 1056 - A 296 5176 Ue	
	Datum Date 1990-02-26 Rev C	Fil File MTS12.1

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1 GENERAL

A fixed terminal is connected with a line interface for packet switching and line connection for line connection traffic (primarily speech). If the fixed terminal is connected to the mains, there are certain requirements for electrical safety.

2 ELECTRICAL SAFETY

For information about electrical safety requirements, please refer to R1-06.

3 SPECIFICATION OF LINE CONNECTION

A fixed terminal should permit line connection traffic as a complement to message traffic. For this to be possible, it is necessary to have a real time connection between terminal and network in addition to the message traffic interface. A connection of this type can be used for transmitting speech for example.

For information about line connection requiremements, please refer to R1-06.

TYPE OF CONNECTION:	4 wire speech connection with one speech direction per line pair.
CONNECTION:	ISO DIS 8877 plug of European or U.S. type.
FREQUENCY RANGE:	300 - 3400 Hz
RECEIVER LEVEL DIRECTION	-15 -- -30 dBm
SENDER LEVEL DIRECTION	-10 -- -23 dBm
SIGNAL/NOISE RATION REC./SEND.:	Greater than 40 dB

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4 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 3

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R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
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EXPLANATION AND MODIFICATIONS

This chapter has been newly added. It is an addendum providing a preliminary specification of additional requirements for portable terminals designed for operation on the Mobitex network. The primary motivation for this addendum is the need to provide a low power operating mode for portable units, to extend the operating time of their self-contained batteries. Because enhancements have been made to network signalling protocols over the air interface, these additional requirements will have some effect on the operation of mobile units as well. A careful review of this chapter is therefore required of all terminal designers and manufacturers.

Since the addendum document was printed, several changes have been made to the protocol. They will be included in a future revision of the ERITEL - provided specification. These changes, which should be applied to the MTS 15.1 document immediately following, are detailed below so that this very important new information can be brought to the attention of interested parties in a timely manner.

1. Section 3.5, page 8: the first paragraph should be changed to read:

   If the terminal has lost consecutive <SVP6> signals over a period less than 60 seconds, it should remain in the operating state to synchronize again. If the terminal has not succeeded in synchronizing within 60 seconds, it should initiate the roaming procedure.

2. Section 3.6, page 12: the two paragraphs under the heading "Evaluation of other base stations" should be changed to read:

   The evaluation of base stations on the CURRENT-SYSTEM-CHANNEL should be based on the average received signal strength over a time period indicated in <SVP6> (default value, 60 seconds).

   The integration time for evaluating base stations on other channels is indicated in <SVP6> (default value, 3 RSSI-PERIODS).

3. Section 3.8.1, page 13: the second paragraph under the heading "UP LINK TRAFFIC" should be changed to read:

   For uplink traffic the terminal should enter the OPERATING state and then follow the normal access rules, i.e., wait for a <FRI> signal and then choose a random slot in which to transmit.

4. Section 3.10, page 17: This section deals with voice operation and may be disregarded.

5. Section 4, pages 25 and 28: Note that the <SVP5> and <SVP6> may contain up to 186 MANs each. A parameter will be added in the currently unused portion of the primary block of <SVP5> and <SVP6> to indicate the number of MANs in the mail list or traffic list, respectively.

6. Section 4, pages 28 and 29: parameters will be added in the currently unused portion of the primary block of <SVP6> to indicate signal strength evaluation times for the CURRENT-SYSTEM-CHANNEL (default 60 seconds) and other channels (default 3 RSSI-PERIODS). (See item 2. above).

7. Section 4, page 29: the entry for "TRANSACTION-TIME" should be changes to read:

   States the time the terminal should stay in OPERATING state after (1) reception of a message from the network, and (2) transmission of a message to the network. (0-255) X 250 ms. Default value: 40 (10 seconds). TRANSACTION-TIME starts after transmitting or recieving an <ACK>, respectively.

8. Section 6, pages 35 and 36: the following three items listed as design recommendations have been changed to design requirements, and their functionality must be included in portable units:

   Automatic change to mobile terminal operation (page 35)

   User notification of 'lost contact' (page 36)

   Display RSSI to user before transmitting (page 36)

The remaining three items - manual selection of operating mode, prevention from automatic quick channel monitoring, and manual initiation of channel monitoring - continue to be design recommendations.

ADDITIONAL INFORMATION

In the "INFO" MPAK (See MTS 09A.2, pages 107 and 108), portable terminals will be defined as terminal type number 4. The INFO MPAK will also now include a parameter indicating the operating mode of the portable unit (mode = mobile terminal mode; mode 1 = battery saving mode).

In the MASC interface (see MTS 19A.2), new commands will be added to accommodate portable terminals. Details will be provided later.

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ADDENDUM
PROTOCOL FOR HAND-HELD PORTABLE TERMINALS FOR USE IN MOBITEX

PRELIMINARY SPECIFICATION.

ABSTRACT

This document specifies additional requirements for hand-held portable terminals to be connected to the MOBITEX system.

An interface for hand-held portable terminals, where power conservation is one prime objective, is defined.

This document should be considered as an ADDENDUM to the MOBITEX Terminal Specification (MTS) for 8 kbps mobile terminals, LZBA 703 1001, R1A.

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1 INTRODUCTION

This document specifies additional requirements for hand-held portable terminals to be connected to the MOBITEX system.

It should be considered as an ADDENDUM to the complete MOBITEX Terminal Specification for 8 kbps mobile terminals, LZBA 703 1001, R1A.

If certain requirements are made for hand-held portables these are made in this document. It could either be new additional requirements or new requirements that replaces ones that are made in the specification for ordinary mobile terminals.

2 GENERAL DESCRIPTION

A hand-held portable terminal is basically a mobile terminal and should therefore conform to the requirements for mobile terminals, but with the additional ability to go into low power drain operating mode and wakeup when required to receive messages from the network.

When the hand-held has received its messages it goes asleep again.

One limitation for portables in this mode is that messages to these terminals may be delayed during the time when the portable is asleep.

Whenever a hand-held wants to send a message it immediately wakes up, waits for a free-signal and sends the message. The terminal then stays awake for a period of time in order to be be able to receive a quick message response.

The roaming procedure is essentially the same as for ordinary mobiles, but is controlled from separate sweep-parameters for hand-held terminals. The hand-held terminals performs the base evaluation during its awake time.

This protocol for hand-held terminals defines four new subtypes of the sweep-signal, <SVP>. These subtypes are numbered from 3 to 6.

<SVP3> - Sweep frame of subtype 3

Includes roaming parameters and channel list used by hand-held terminals. <SVP3> corresponds to <SVP1> used by mobile terminals.

<SVP4> - Sweep frame of subtype 4

Contains channel numbers and channel types used in fleet division procedure. <SVP4> corresponds to <SVP2> used by mobile terminals.

<SVP5> - Sweep frame of subtype 5

Contains a list of terminal MAN that has messages stored in the network mailbox.

<SVP6> - Sweep frame of subtype 6

Contains a list of terminal MAN or Group MAN that will have traffic from the network during this sweep cycle.

This sweep frame also contains timing parameters for synchronization and message transfer.

3 OPERATING PRINCIPLES

3.1 START UP PROCEDURE

When the portable is powered up for the first time and/or when it has lost synchronization with the network or lost important information/parameters, it should consider itself to be in normal mobile terminal mode and act according to that.

When the hand-held has found a system channel on a base station to use, received the relevant parameters from the base and synchronized to it, the terminal should send MPAK ROAM or ACTIVE according to the roaming procedure.

The hand-held always has the possibility to go to normal mobile terminal mode, e.g. when the terminal is put in a power charger or for a major data transaction session when you want to be active all the time. In order to inform the network of this change of mode, the hand-held sends a new MPAK called MODE.

3.2 STATES

There are two different states that a hand-held terminal could enter when it is in the low power drain mode; STANDBY state or OPERATING state.

The STANDBY state should be considered as a 'sleeping' mode where only time keeping functions for synchronizing the terminal to the base station are in operation.

In the OPERATING state the terminal should be considered as fully operational.

3.3 TRAFFIC LIST

The hand-held terminal is notified in a TRAFFIC LIST that traffic will sent to the terminal.

The TRAFFIC LIST contains the TERMINAL-MAN or the GROUP-MAN of those terminals that should remain in the OPERATING state in order to be available for the down-link traffic from network.

The TRAFFIC LIST is part of a new <SVP>-frame of SUBTYPE 6, denoted <SVP6>-frame.

Terminals not included in the TRAFFIC LIST may directly go back to STANDBY state in order to save battery.

3.4 MAIL LIST

Messages not acknowledged by the terminal may be stored in the network mailbox according to the conditions describes in R1-09, 8kbps MTS.

In order to inform terminals that have messages in the network mailbox, the MAIL LIST is introduced.

The MAIL LIST contains a list of those terminal MAN having messages in the mailbox. The MAIL LIST is within the <SVP>-frame of subtype 5, denoted <SVP5>.

3.5 SYNCHRONIZATION TO THE NETWORK

Hand-held terminals using the this battery saving protocol cyclically goes from the STANDBY state to the OPERATING state.

The terminal must be synchronized to the <SVP6> (TRAFFIC LIST) sent from the network. The <SVP6> frame is sent periodically from the network on the system channels where hand-held terminals can operate and use the battery saving protocol.

The <SVP6> also contains the parameter TIME-TO-NEXT indicating the remaining period of time from this <SVP6> to the next time the terminal should enter the OPERATING state.

TIME-TO-NEXT = time from first bit (bit 1) in the framehead of the received <SVP6> to the next time the terminal should enter the OPERATING state.

The <SVP6> also contains the parameter CYCLE-TIME which is the nominal cycle time between the start of two operating states.

The length of the CYCLE-TIME parameter is a compromise between response-time requirements and power consumption requirements of the terminal.

Normally the terminal uses the TIME-TO-NEXT parameter in the <SVP6> to synchronize to the next time to enter the OPERATING state. If one or more of the <SVP6> frames are lost, the terminal should use the CYCLE-TIME parameter in order not to lose synchronization.

Once the terminal has entered the OPERATING state it remains in this state until it receives an <SVP6> frame with a TRAFFIC LIST where the terminal is not included. The <SVP6> is terminating the transmission of the sweep frames.

If the network is going to send other sweep frames when the terminals are in the OPERATING state, they will be sent prior the <SVP6> frame.

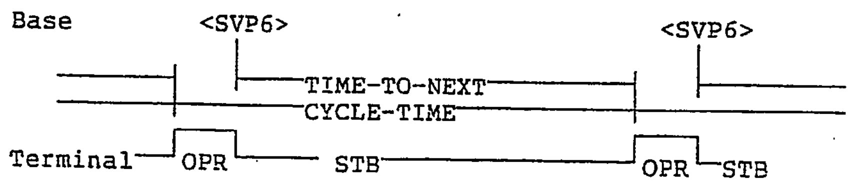
If none of the <SVP3> to <SVP6> has been received within 2 seconds from the transition to the OPERATING state, the terminal could return to STANDBY.

After the reception of every <SVP3> to <SVP5> the terminal stays in OPERATING state for another 2 seconds or till it receives an <SVP6>.

If the hand-held consider itself as having lost synchronization to the network, e.g. lost of a number of consecutive <SVP6>, it should stay in OPERATING state to synchronize again.

Example 1 :

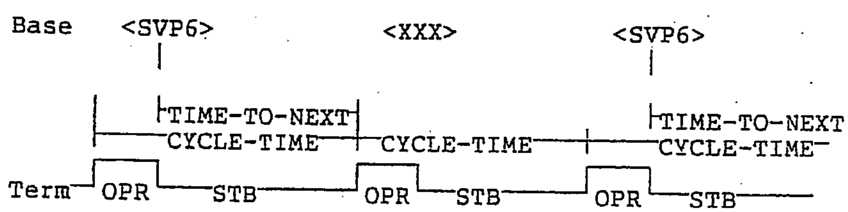
Terminal uses TIME-TO-NEXT for synchronizing.



OPR = terminal in OPERATING state
STB = terminal in STANDBY state

Example 2:

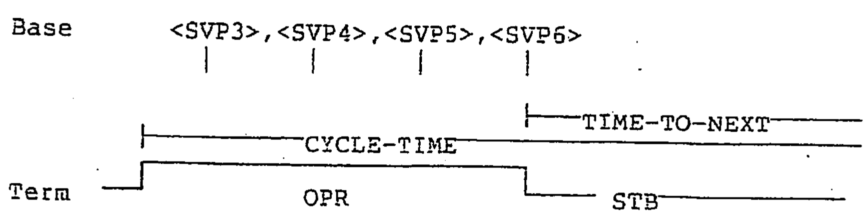
Terminal is using the CYCLE-TIME when <SVP6> is lost to keep synchronization.



OPR = terminal in OPERATING state
STB = terminal in STANDBY state

Example 3:

Multiple sweep frame could be sent during the OPERATING state.



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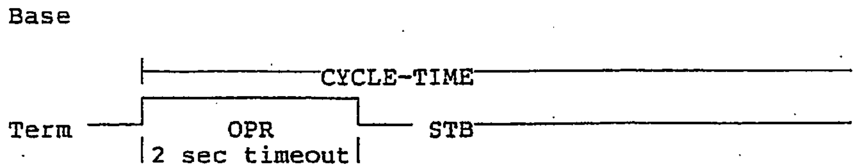
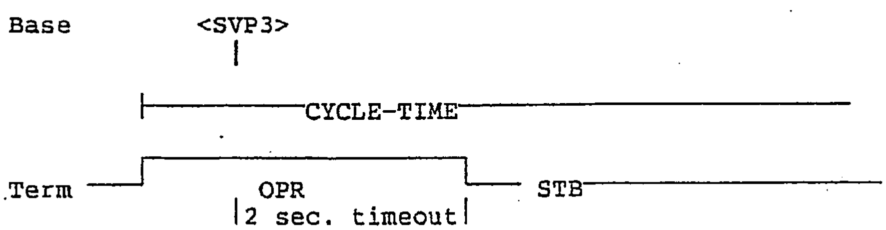
Example 4 :

Terminal does not receive any sweep frame within 2 seconds from the start of the OPERATING state and returns to STANDBY.



Example 5:

The terminal receives a <SVP3> but the <SVP6> is not received so the OPERATING state is terminated by the 2 second timeout.
The timeout is counted from the reception of the <SVP3> frame.



3.6 ROAMING

The roaming procedure for hand-held terminals follows basically the roaming procedure for mobile terminals described in R1-16.

Since a hand-held terminal is most of the time in the STANDBY state, the normal monitoring of the roaming procedure must be carried out during the time when the terminal is in the OPERATING state. During the OPERATING state the terminal measures the averaged received signal strength and calculates a roaming value.

The system parameters controlling the roaming procedure for hand-held portables are defined in the <SVP3>-frame. This gives the possibility to have different parameters for mobile terminals (defined in the <SVP1> frame) and for hand-held portables.

In order to control the performance of the terminals roaming procedure, different roaming parameters can be set in the <SVP3>-frame from the network. Here are some examples described and the impacts on the terminals performance.

<u>Example 1:</u>

If SCAN_TIME = 0 the terminal only monitors the CURRENT_SYSTEM_CHANNEL during the OPERATING state.

At evaluation, if the roaming value < BAD_BASE the terminal goes to the 'quick channel monitoring' procedure since no other channels has been detected.

m = monitor CURRENT_SYSTEM_CHANNEL
OPR = terminal in OPERATING state
STB = terminal in STANDBY state

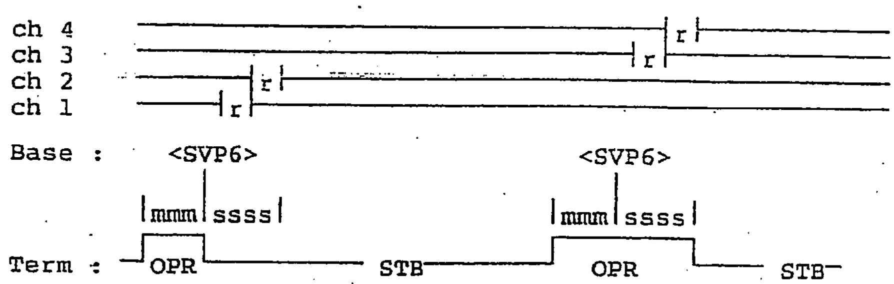
The other sweep frames are not shown in this figure but are coming before the <SVP6> frame if they are sent out.

Example 2 :

If SCAN_TIME = 1 ... 255, the terminal monitors other channels according to the channel list information the mobile has derived in the <SVP3> or from the default list.

The start of the scan period is only critical in that sense that the terminal must not leave the system channel and monitor another channel when it should be in OPERATING state.

The terminal should not leave CURRENT_SYSTEM_CHANNEL and monitor other channels during the sweep cycle if it is addressed in the TRAFFIC LIST.



m = monitor CURRENT_SYSTEM_CHANNEL
s = scan other system channels
r = RSSI_PERIOD
OPR = terminal in OPERATING state
STB = terminal in STANDBY state

Please see the chapter ROAMING in R1-16 for further information.

Criteria for leaving base :

The same criteria for leaving the CURRENT_BASE applies for a hand-held terminal as the mobile terminal but with the parameters in the <SVP3> frame. The fifth criteria (item -5-) is not valid for hand-held terminals.

Please see the chapter ROAMING in R1-16 for further information.

Evaluation of other base stations :

The evaluation of base stations on the CURRENT_SYSTEM-_CHANNEL, should be based on the averaged received signal strength from at least 60 seconds or some other suitable integration time.

When evaluating other channels than the CURRENT_SYSTEM_CHANNEL, roaming values from at least three (3) RSSI_PERIODS should be averaged.

Quick channel monitoring :

In quick channel monitoring when the SCAN_TIME = 0 and when the terminal has found a channel with a roaming value > GOOD_BASE, the terminal should remain on the channel for at least 5 seconds during the measuring of received signal strength. Please refer to 'quick channel monitoring' part (item -4-) of the ROAMING chapter in R1-16.

At Power On

When the hand-held terminal is switched on it should use the stored CURRENT_SYSTEM_CHANNEL and the CURRENT_BASE.

If there is no CURRENT_BASE stored the terminal directly starts the quick channel monitoring procedure using the default list of system channels. When a CURRENT_SYSTEM-_CHANNEL and a CURRENT_BASE has been found and the MPAK ROAM has been sent to the network, the terminal synchronizes to the <SVP6>-frames.

3.7 FLEET DIVISION OF HAND-HELD PORTABLES

In order to assign a certain system channel (and/or access channel) to hand-held terminals or parts of the fleet of the hand-held terminals a <SVP>-frame of SUBTYPE 4 is introduced, denoted <SVP4>-frame. The <SVP4>-frame should be interpreted in same way as the <SVP2>-frame for mobile terminals, described in 8kbps MTS section R1-16.

3.8 MESSAGE TRANSACTIONS

3.8.1 UP LINK TRAFFIC

The access requirements for up-link traffic from a hand-held terminal are basically the same as for a mobile terminal.

A hand-held terminal that is going to transmit a message to the network enters the OPERATING state directly and waits for a valid <FRI>-frame from the network according to the 8kbps MTS.

When the terminal makes an access request for data using the <ABD>-frame , the terminal should follow the 8kbps MTS dialogues and remain in OPERATING state till the <MRM>-frame is transferred successfully or when the dialogue terminates for any reason.

After the message is successfully transferred to the network the hand-held terminal remains in OPERATING state for TRANSACTION-TIME, defined in <SVP6>, before it goes back to STANDBY state. This gives a possibility for transferring an answer back to the hand-held without any delays caused by the waiting time to the next TRAFFIC LIST transmission. This function could be considered as if a 'logical down-link channel' has been opened to the terminal for TRANSACTION-TIME.

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3.8.2 DOWN LINK TRAFFIC

Hand-held terminals having down-link traffic is addressed in the TRAFFIC LIST.

When the hand-held terminal receives a TRAFFIC LIST that contains one of its terminal addresses (TERMINAL MAN or GROUP MAN) it stays in OPERATING state and awaits one message.

When the message is successfully received the terminal stays in OPERATING state for TRANSACTION-TIME in order to be able to receive more down-link messages coming from the network. The parameter TRANSACTION-TIME is included in the <SVP6>-frame, and is the same as for up-link traffic.

If no message has been received within the TRANSACTION-TIME elapsed from the reception of the last message, the terminal can leave OPERATING state.

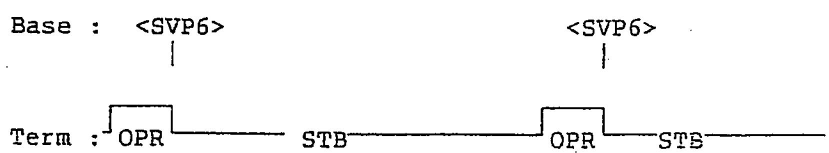
The terminal can also leave OPERATING state when it receives a TRAFFIC LIST without any of the terminal addressees.

When a hand-held terminal is ordered to another channel for down-link data transmission, <BKD> frame from network, the hand-held terminal should remain in the OPERATING state until the data transmission dialogue is completed according to the 8kbps MTS.

Terminals not included in the TRAFFIC LIST may directly go to STANDBY state in order to save battery.

<u>Example 1:</u>

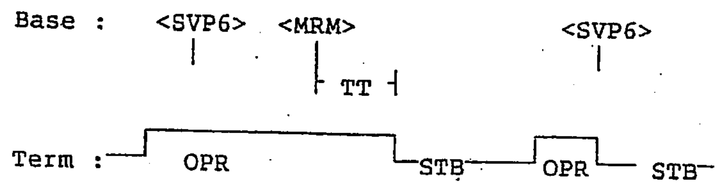
Terminal is not in traffic list



OPR = terminal in OPERATING state
STB = terminal in STANDBY state

Example 2:

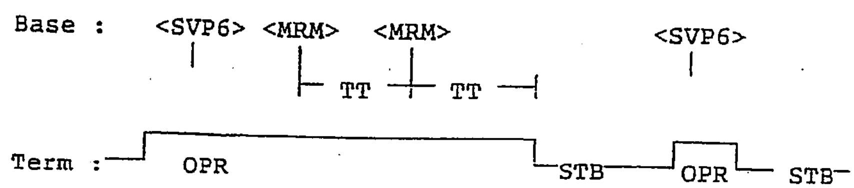
Terminal is in traffic list of <SVP6> and the network has one <MRM> to transmit.



TT = TRANSACTION-TIME
OPR = terminal in OPERATING state
STB = terminal in STANDBY state

Example 3:

Terminal is in traffic list of <SVP6> and the network transmits multiple <MRM> within the sweep cycle.



TT = TRANSACTION-TIME
OPR = terminal in OPERATING state
STB = terminal in STANDBY state

3.9 ACTIVATION/INACTIVATION

The hand-held terminal use of the ACTIVE/INACTIVE packet has been modified to better suit their environment and application.

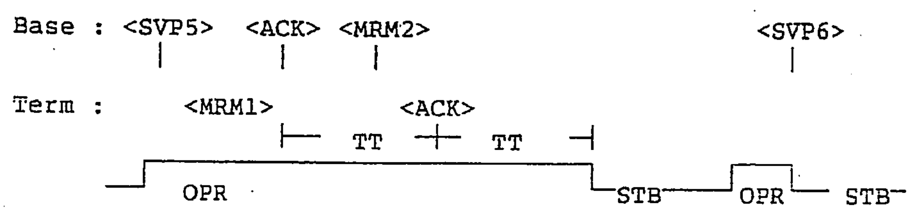
Hand-held portables used in-doors will lose contact with the network much more frequently then mobile terminals. Hand-held terminals should therefore not send ACTIVE due to 'lost contact' according to the roaming procedure since this will cause considerable system signalling overhead.

Hand-held terminals should send INACTIVE / ACTIVE when switched-off and switched-on respectively.

When a hand-held terminal is addressed in the MAIL LIST it has the possibility to empty the mailbox by sending an ACTIVE packet.

Example 1:

Terminal is in mail list of <SVP5> and the network has one or more <MRM> placed in mailbox.



TT = TRANSACTION-TIME
OPR = terminal in OPERATING state
STB = terminal in STANDBY state
MRM1 = MPAK ACTIVE
MRM2 = any MPAK from mailbox

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3.10 LINE CONNECTION

Call set-up and disconnection procedures for line connection to a hand-held terminal follows the requirements in the 8kbps MTS.

When a hand-held terminal is called from the network for a line connection, the terminal is addressed in the TRAFFIC LIST with the TERMINAL MAN or one of the GROUP MAN. The terminal remains in the OPERATING state and follows the normal procedure for call set-up described in the 8kbps MTS. The terminal can leave the OPERATING state when the call is disconnected, according to the dialogues in the 8kbps MTS.

When a hand-held terminal initiates a call set-up for a line connection, the terminal enters OPERATING state before sending the line connection request, and stays in this state until the call is disconnected, according to the 8kbps MTS.

4 ADDITIONAL FRAMES - DATA LINK LAYER

FRAME TYPE <SVP>, Sweep signal

APPLICATION The sweep signal is a periodically recurring signal from BASE. An <SVP> is transmitted by BASE for two reasons:

1) <SVP> marks the start of a sweep cycle.

2) <SVP> contains system parameters.

<SVP> has 2 different subtypes for mobile terminals and 4 subtypes for hand-held portable terminals :

SUBTYPE

1 states the values of system parameters for mobile terminals

2 states the frequency of different channel types for mobile terminals

3 subtype only for hand-held terminals using the battery saving protocol described in this document. This subtype contains the system parameters for the hand-held terminals.

4 states the frequency of different channel types for hand-held terminals.

5 includes the MAIL LIST for terminals (may be used both by mobile terminals and hand-held terminals)

6 includes the TRAFFIC LIST and the timing parameters for hand-held terminals

Note 1: <SVP> of subtype 1 and 2 are not described in this Addendum. Please refer to 8kbps MTS R1-16.

Note 2: For <SVP5> and <SVP6>, the hand-held should use correctly received following blocks, even though the whole frame may not be correct.

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<SVP>, SUBTYPE 3 — states the values of system parameters for hand-held terminals.

PRIMARY BLOCK

01 02 03 ... 22 23 24	25 26 27	28 29 30 31 32
MOB	0 0 0	0 1 1 1 1

33 34 35	36 37 38 39 40	41 42 43 44 45 46 47 48
PRIO	MASK	BLOCK

49 50 51 52 53 54 55 56	57 58 59 60 61 62 63 64
SVPTYP	TXPOW

65 66 67 68 69 70 71 72	73 74 75 76 77 78 79 80
RSSI_PROC	RSSI_PERIOD

81 82 83 84 85 86 87 88	89 90 91 92 93 94 95 96
0 0 0 0 0 0 0 0	MAX_REP

97 ... 104	105 ... 112
BASEST	SCAN_TIME

113 ... 120	121 ... 128
BAD_BASE	GOOD_BASE

129 ... 136	137 ... 144
BETTER_BASE	0 0 0 0 0 0 0 0

145 ... 160
PARITY

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SVPTYP	States the <SVP> subtype, value 00000011 in this case.
TXPOW	States the decrease in output power (0-255 dB below nominal level) to be used by the hand-held terminal. The default value of 0 is used until this signal is received.
RSSI_PROC	States the method of the signal strength measurement: 0 = FRAME 1 = CONTINUOUS The default value is FRAME.
RSSI_PERIOD	Time used by the roaming algorithm (0-255 *20 ms). Default value: 148 (2 960 ms).
MAX_REP	States the value of the variable Max_rep.
BASEST	States status of base station.
SCAN_TIME	States the length of a period (0-255 *100 ms) when the hand-held terminal scans other system channels. Default value: 30 (3 seconds).
BAD_BASE	Used by the roaming algorithm. 0-255 dBuV. Default value: 15.
GOOD_BASE	Used by the roaming algorithm. 0-255 dBuV. Default value: 15.
BETTER_BASE	Used by the roaming algorithm. 0-255 dB. Default value: 10.

FOLLOWING BLOCKS

If any, they contain a list of system channels to be used in base station monitoring. A frame with a list containing new system channels completely overrides the previous frame. The channel list has the following format (as described in the MAIN DOCUMENT):

FOLLOWING BLOCK #1

01–08	09	10	11	12	13	14	15	16
number of channels	0	0	0	0	0	0	0	0

17 – 32	33 – 48
channel #1 - UPFREQ	channel #1 - DOFREQ

49 – 64	65 – 80
channel #2 - UPFREQ	channel #2 - DOFREQ

81 – 96	97 – 112
channel #3 - UPFREQ	channel #3 - DOFREQ

113 – 128	129 – 144
channel #4 - UPFREQ	channel #4 - DOFREQ

145 – 160
PARITY

The number of following blocks depends on the size of the list. The maximum number of channels in the list is stated in reference R1-06.

Continues with following block #2 on the next page.

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FOLLOWING BLOCK #2

01 – 16	17 – 32
channel #5 - UPFREQ	channel #5 - DOFREQ

33 – 48	49 – 64
channel #6 - UPFREQ	channel #6 - DOFREQ

.
.
.

129 – 144	145 – 160
channel #9 - UPFREQ	PARITY

FOLLOWING BLOCK #3

01 – 16	17 – 32
channel #9 - DOFREQ	channel #10 - UPFREQ

33 – 48	49 – 64
channel #10 - DOFREQ	channel #11 - UPFREQ

etc.

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<SVP>, SUBTYPE 4 — states the frequency of different channel types for hand-held terminals.

PRIMARY BLOCK

01 02 03 — 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	1	1	1	1

33 34 35	36 37 38 39 40	41 42 43 44 45 46 47 48
PRIO	MASK	BLOCK

49 50 51 52 53 54 55 56	57 58 59 60 61 62 63 64
SVPTYP	CHATYP

65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
UPFREQ

81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96
DOFREQ

97	98	99	100			—						144
0	0	0	0	0	0	—	0	0	0	0	0	0

145 — 160
PARITY

SVPTYP States the <SVP> subtype, value 00000100 in this case.

CHTYP States the type of channel:

Value:

1	Local system channel opened
2	Not used (ignore that order)
3	Local system channel closed (return to previous system channel)
4	Access channel opened
5	Access channel closed

UPFREQ Frequency number for up frequency, i.e. the frequency on which the terminal transmits.

DOFREQ Frequency number for down frequency, i.e. the frequency on which BASE transmits.

FOLLOWING BLOCK No following blocks in this type of frame.

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<SVP>, SUBTYPE 5 - contains a list of terminal MAN that has messages stored in the network mailbox

PRIMARY BLOCK

01 02 03 — 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	1	1	1	1

33 34 35	36 37 38 39 40	41 42 43 44 45 46 47 48
PRIO	MASK	BLOCK

49 50 51 52 53 54 55 56	57	58	59	60	61	62	63	64
SVPTYP	0	0	0	0	0	0	0	0

65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

97							104	105							112
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

113							120	121							128
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

129							136	137							144
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

145 — 160
PARITY

SVPTYP States the <SVP> subtype, value 00000101 in this case.

FOLLOWING BLOCKS — Containing a list of terminal MAN that has been stored in the network mailbox.

FOLLOWING BLOCK #1

01–24	MAN 1
25–48	MAN 2
49–72	MAN 3
73–96	MAN 4
97–120	MAN 5
121–144	MAN 6
145–160	PARITY

The number of following blocks depends on the size of the list.

Continues with following block #2 on the next page.

FOLLOWING BLOCK #2

01 … 24
MAN 7

25 … 48
MAN 8

49 … 72
MAN 9

73 … 96
MAN 10

97 … 120
MAN 11

121 … 144
MAN 12

145 … 160
PARITY

etc.

<SVP>, SUBTYPE 6 - contains the timing parameters used in synchronization and message transactions

PRIMARY BLOCK

01 02 03 ... 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	1	1	1	1

33 34 35	36 37 38 39 40	41 42 43 44 45 46 47 48
PRIO	MASK	BLOCK

49 50 51 52 53 54 55 56	57 58 59 60 61 62 63 64
SVPTYP	CYCLE-TIME

65 66 67 68 69 70 71 72	73 74 75 76 77 78 79 80
TIME-TO-NEXT	TRANSACTION-TIME

81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

97							104	105							112
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

113							120	121							128
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

129							136	137							144
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

145 ... 160
PARITY

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SVPTYP	States the <SVP> subtype, value 00000110 in this case.
CYCLE-TIME	States the cycle time between two OPERATING states (0-255 x 250 ms).
TIME-TO-NEXT	States the time to the next <SVP6> frame (0-255 x 250 ms).
TRANSACTION-TIME	States the time the terminal should stay in OPERATING state after 1) reception of a message from the network and 2) transmission of a message to the network (0-255 x 250 ms). Default value: 80 (20 seconds.

FOLLOWING BLOCKS — Containing a list of terminal MAN or group MAN that are going have down-link traffic during this sweep cycle.

FOLLOWING BLOCK #1

01 – 24	MAN 1
25 – 48	MAN 2
49 – 72	MAN 3
73 – 96	MAN 4
97 – 120	MAN 5
121 – 144	MAN 6
145 – 160	PARITY

The number of following blocks depends on the size of the list.

Continues with following block #2 on the next page.

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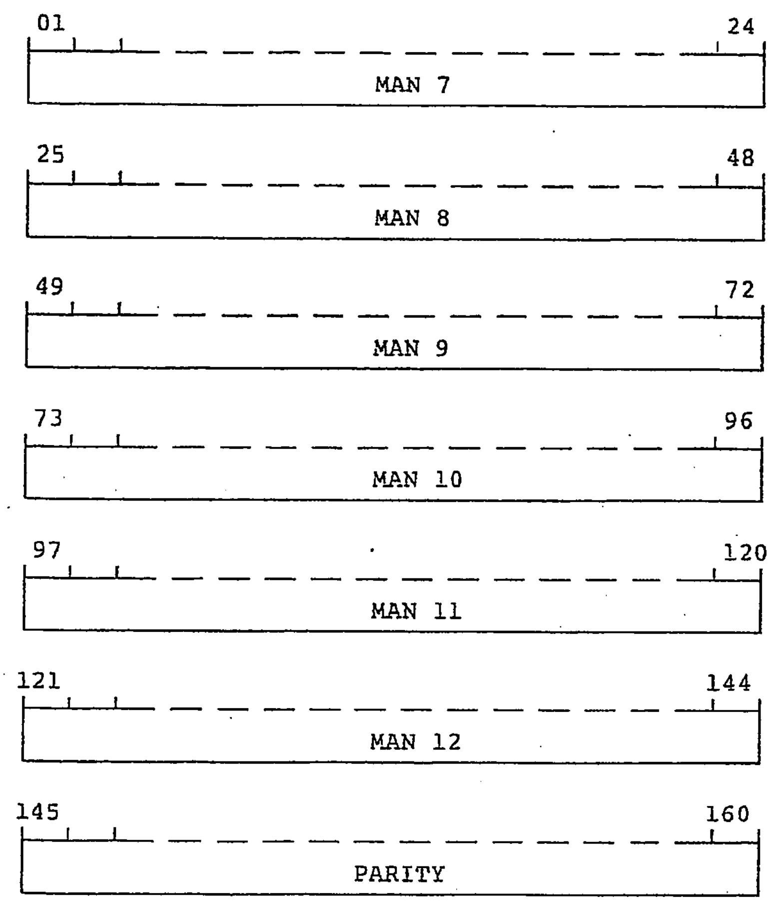
FOLLOWING BLOCK #2



etc.

5 ADDITIONAL MPAK - NETWORK LAYER

A new MPAK is included for terminals using the battery saving protocol. The MPAK is used to inform the network that the terminal has changed from battery saving mode to operate as a normal mobile terminal and vice versa.

The new MPAK is within the packet class DTESERV (3) and has the packet type = 24.

MODE (mode information):

Designated sender:

The hand-held portable terminal.

Designated addressee:

The network.

Raised flags:

No raised flags.

Criteria for generating the packet:

When hand-held portable terminal changes from the battery saving protocol to operate as a mobile terminal this packet is used to inform the network.

The same packet is sent to the network, but with a different mode identifier, when the terminal enters the battery saving protocol from being operating as a mobile terminal.

The network's normal action when receiving the packet:

The network registers how the terminal operates, and forwards down-link traffic to the terminal in accordance to this. If terminal is using the battery saving protocol, the terminal is addressed in the TRAFFIC LIST.

If the terminal is operating as a mobile terminal the network sends traffic immediately to the terminal.

The terminal's normal action when receiving the packet:

The terminal does not normally receives this packet.

Length of the packet:
9 octets.

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MODE as generated by the terminal:

MPAK-COMMON COMPONENT:

octet 1-3: sender: the terminal

octet 4-6: addressee : the Mobitex Network

octet 7:

0	0	0	0	0	0	0	0

octet 8:

1	1	0	1	1	0	0	0

TYPE DEPENDENT COMPONENT:

octet 9 : mode identifier

mode identifier :

0 = mobile terminal operation

1 = battery saving protocol operation

2-255 = reserved

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6 DESIGN RECOMMENDATIONS

Manual selection of Battery saving operating mode - Mobile terminal operating mode

When the hand-held terminal is mounted into a battery charger in a car for example, it is recommended that terminal leaves the battery saving protocol operation and operates as mobile terminal. In that case the user or the terminal itself initiates the transmission of the MPAK MODE to the network. The MPAK MODE will then identify the operating mode the terminal uses.

Automatic change to mobile terminal operation.

If the terminal could not find any signalling required for the battery saving protocol operation (<SVP6>), but detects <SVP1> required for mobile terminal operation, the terminal could act as mobile terminal. The user should be informed of this so the terminal could be switched-off.

The MPAK MODE is sent to the network informing that the terminal has gone into mobile terminal operation.

Prevention from automatic quick channel monitoring

In order to prevent the automatic quick channel monitoring from continuously running or to prevent the terminal from repeated attempts to go into the quick channel monitoring, it is recommended that the user manually can switch the quick channel monitoring function off.

It is also recommended that the terminal has some kind of watchdog function implemented, limiting the operating time in quick channel monitoring mode.

Manual initiation of quick channel monitoring

If the hand-held terminal is implemented without automatic quick channel monitoring functions it is recommended that this function can be manually initiated.

User notification of 'lost contact'

When the terminal loses contact with network, according to roaming procedure, and goes into quick scan monitoring the operator of terminal should be notified. It is also suitable if the received signal strength indication (RSSI) is displayed to the user so positioning of the terminal could be facilitated.

RSSI when transmitting

It is recommended to display the received signal strength to the user especially when the terminal is going to transmit, so the user can move the terminal to a good location.

7 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 21
R1-09, 6
R1-16, 10, 11, 12, 13, 18

Below are the reference designations listed.

Reference	Section
R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05	References
R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

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		REQUIREMENT SPECIFICATION	1(63)
Uppgjord - Prepared: ET/SYS IK	Faktaansvarig - Subject responsible: ET/SYS IK	Nr - No: 9/1056 - A 296 5171/02 Ue	
Dokansv/Godkänd - Doc respons/approved: ET/SYSC STT STT		Datum - Date: 1990-02-26 Rev: A	Fil - File: MTS16.2
Benämning: Cantel Mobitex		Title: MOBITEX Data Link Layer, Mobile Terminal 8/16 kbps	

ABSTRACT

This document specifies the data link layer for terminals connected to the MOBITEX network.

The mobile terminal's Data Link Layer together with the Physical Layer form a radio protocol for communication between mobile stations (MOB) and a base radio station (BASE).

The interchange of information between BASE and MOB is in the form of frames. There are 21 different types of frames.

A number of different access strategies are used in the protocol to permit the handling of a large number of mobile terminals on a few trunked channels. The most important aspects are:

- Time slots
- Selective repetition
- Priority access
- Concurrent channels
- Automatic roaming

To achieve high transmission reliability, the frames are divided into blocks where each block is coded.

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1 INTRODUCTION

1.1 GENERAL

The Link Layer of mobile terminals forms a link between the Network Layer and the physical radio channel with its special properties. It ensures a safe and efficient transmission path between the mobile terminal and the network, represented by the base stations. The Link Layer includes error correction facilities, access algorithms, roaming algorithms, priority facilities etc.

2 INTERACTION WITH UPPER LAYERS

The upper layers handle packets of information, MPAK. The following figure presents the general apperance of an MPAK (it is fully described in reference R1-09).

Sender
Addressee
Type, status etc.
Type-dependent component

The Link Layer transmits the MPAK in the form of a frame. The frame structure is defined in chapter FRAME STRUCTURE. The conversion of a packet into a frame is described in APPENDIX A.

If the Link Layer is unsuccessful in transferring an MPAK to the network, it is returned to the Network Layer with this information. The Network Layer can then request a new attempt by sending the MPAK back to the Link Layer.

3 FRAME STRUCTURE

3.1 PARTS OF THE FRAME

The transmission of digital information over the radio channel is performed by transmitting frames. A frame comprises a limited number of bits which are transmitted in an uninterrupted sequence. The frame consists of the following parts:

sync pattern, base identity	Frame head
MOB address etc.	Primary block
Parity field	Primary block
Information field	Following block #1
Parity field	Following block #1
...	
Information field	Following block #n
Parity field	Following block #n

The frame head is described in detail in reference R1-17. The information and parity fields of the following blocks are described in APPENDIX A, together with the primary block.

3.2 FRAME TYPES

There are 21 different frame types:

	Name	Designation	Transmitted by BASE	Transmitted by MOB
1	M frame	<MRM>	Yes	Yes
2	Acknowledgement	<ACK>	Yes	Yes
3	Negative acknowledgement	<NAK>	Yes	Yes
4	Repetition request	<REB>	Yes	Yes
5	Repetition reply	<RES>	Yes	Yes
6	Access request, data	<ABD>	No	Yes
7	Access request, speech	<ABT>	No	Yes
8	Access request, emergency	<ABL>	No	Yes
9	Access permission, data	<ATD>	Yes	No
10	Access permission, speech	<ATT>	Yes	No
11	Access permission, emergency	<ATL>	Yes	No
12	Change channel, data	<BKD>	Yes	No
13	Change channel, speech	<BKT>	Yes	No
14	Free signal	<FRI>	Yes	No
15	Sweep signal	<SVP>	Yes	No
16	Silence order	<TST>	Yes	No
17	Activity request	<AKT>	Yes	No
18	No access permission, speech	<NAT>	Yes	No
19	Change base station, speech	<BBT>	Yes	No
20	Wait for channel, speech	<VKT>	Yes	No
21	Cancel access request, speech	<AAT>	No	Yes

The following pages give a brief description of each frame type. Refer to Appendix A "Frames" for a complete definition of frame types.

1 **M-frame** **<MRM>**

An <MRM> is used to transfer packets (MPAKs). The packet formats are defined in reference R1-09.

2 **Acknowledgement** **<ACK>**

An <ACK> acknowledges a correctly received frame.

<ACK> indicates that all blocks in the frame have been correctly received. It includes the sequential number of the received frame.

3 **Negative acknowledgement** **<NAK>**

A <NAK> requests repetition of the entire <MRM>.

<NAK> indicates that the primary block has been correctly received, but that the following blocks have been lost. It contains the sequential number of the received primary block. <NAK> results in a complete repetition of the lost <MRM>.

Note that if the number of blocks in <MRM> was 3 or more, <REB> is used instead of <NAK>.

4 **Repetition request** **<REB>**

A <REB> requests repetition of erronous blocks in an <MRM> or <RES>.

If it is found during reception that certain blocks in a frame are not correct, a request for these blocks to be repeated can be made by transmitting a <REB>. The request contains a bit map of the blocks to be repeated. This bit map refers to the original <MRM>, even during a sequence of repetitions.

<REB> contains the sequential number of the received <MRM> and results in a <RES>.

Note that if the number of blocks in <MRM> was 2 or less, <NAK> is used instead of <REB>.

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5 **Repetition reply <RES>**

A <RES> is the reply to a <REB>.

<RES> is a selective repetition of blocks from an <MRM>. The following blocks of the <RES> contain copies of blocks according to the bit map of the <REB>. <RES> contains the sequential number of the original <MRM>.

6 **Access request, data <ABD>**

An <ABD> is a request to transmit an <MRM>, containing "data" (defined in chapter "Addressing a mobile terminal"), whose length (number of blocks) exceeds the value of MAX_ACCESS. MAX_ACCESS is described in chapter "Time division".

If the length of the <MRM> exceeds MAX_ACCESS, access must be requested before the <MRM> may be sent.

The <ABD> states the number of blocks in the corresponding <MRM>.

7 **Access request, speech <ABT>**

An <ABT> is a request to transmit an <MRM>, containing "speech" (defined in chapter "Addressing a mobile terminal"), containing a request for a line connection whose length (number of blocks) exceeds the value of MAX_SPEECH. MAX_SPEECH is described in chapter "Time division".

If the length of an <MRM> with a connection request exceeds MAX_SPEECH, access must be requested before the <MRM> may be sent.

The <ABT> states the number of blocks in the corresponding <MRM>.

8 **Access request, emergency <ABL>**

An <ABL> is a request to transmit an <MRM> containing an "emergency" (defined in chapter "Addressing a mobile terminal"), whose length exceeds the value of MAX_ACCESS. MAX_ACCESS is described in chapter "Time division".

If the length of the <MRM> exceeds MAX_ACCESS, access must be requested before the <MRM> may be sent.

The <ABL> states the number of blocks in the corresponding <MRM>.

9 **Access permission, data <ATD>**

BASE replies with an <ATD> to an <ABD> from a MOB, when BASE is ready to accept an <MRM>.

When permission is granted (<ATD> received), MOB is expected to transmit an <MRM> containing a data packet.

10 **Access permission, speech <ATT>**

BASE replies with an <ATT> to an <ABT> from a MOB, when BASE is ready to accept an <MRM>.

When permission is granted (<ATT> received), MOB is expected to transmit an <MRM> containing a request for line connection.

11 **Access permission, emergency <ATL>**

BASE replies with an <ATL> to an <ABL> from a MOB, when BASE is ready to accept an <MRM>.

When permission is granted (<ATL> received), MOB is expected to transmit an <MRM> containing an emergency signal.

12 **Change channel, data** <BKD>

A <BKD> orders a MOB to another channel in order to transmit or receive an <MRM>, data or emergency.

Normally the terminal returns to the original channel when the <MRM> has been transmitted or received. If an error occurs on the assigned channel then MOB returns to the original channel after a timeout period stated in the <BKD>.

13 **Change channel, speech** <BKT>

A <BKT> orders a MOB to another channel in order to transmit or receive an <MRM> containing a request for line connection.

Normally the terminal returns to the original channel when the line connection is over. If an error occurs on the assigned channel then MOB returns to the original channel after a timeout period stated in the <BKT>.

14 **Free signal** <FRI>

BASE transmits a <FRI> when it is ready to handle traffic from MOB.

A free signal precedes a free cycle. A free cycle is a period of time when all of, or parts of, the total fleet of mobile terminals are collectively permitted to transmit.

15 **Sweep signal** <SVP>

The sweep signal is a periodically recurring signal from BASE. An <SVP> is transmitted by BASE for two reasons:

1 <SVP> marks the start of a sweep cycle.

2 <SVP> contains system parameters, such as:

- time to next <SVP>
- maximum number of repetitions
- channel list
- local system channel
- access channel

16 **Silence order** <TST>

Silence order is used by BASE to withdraw all access permissions during a free cycle. A MOB that is already transmitting may continue to do so, but for every other MOB the access permissions for all traffic types (emergency, speech and data) are withdrawn.

Note: Please also refer to the description of the silence signal in reference R1-17. This signal has the same meaning as the <TST>-frame but uses only the frame head and thus addresses ALL mobile terminals.

17 **Activity request** <AKT>

An <AKT> is used by BASE to check whether a certain MOB is active. MOB replies with an <ACK> to such a frame.

18 **No access permission, speech** <NAT>

BASE replies with <NAT> to an <ABT> from a MOB when, for some reason, a line connection cannot be set up (e.g. no channel is available).

19 **Change base station, speech** <BBT>

BASE will use <BBT>

- as a response to an <ABT> when another base station is to be used for the line connection

or

- to hand over a call in progress to another base station.

20 **Wait for channel, speech** **<VKT>**

If no channel is immediately available, BASE may place MOB in a queue of waiting calls and reply with a <VKT> to a received <ABT>. When a speech channel becomes available, BASE indicates this by transmitting a <BKT> to MOB. If there is no free channel within reasonable time, BASE ends the session by transmitting a <NAT>.

21 **Cancel access request, speech** **<AAT>**

After having received a <VKT> from BASE, the mobile terminal may end the session by transmitting an <AAT>.

4 TRAFFIC HANDLING

4.1 TRANSMISSION PRINCIPLES

Transmission is carried out through the interchange of frames between MOB and BASE. Different types of transmission cases demand different behaviours by the units involved. Some of the problems considered in this chapter are:

Access to the channel	- describes how a small number of channels can handle concurrent traffic from a large number of subscriptions at the same time.
Keeping contact with the network	- describes how the mobile unit maintains its contact with the network (roaming).
Addressing	- describes how the addressing of base radio stations, terminals and subscriptions take place.
Sequential numbering	- describes how repeated presentations of repeated frames are avoided.

4.2 ACCESS TO THE CHANNEL

4.2.1 Time division

A MOB, with traffic to send, is allowed to establish contact with the base radio station in special free cycles. These cycles are initiated by BASE by transmitting a <FRI>.

This frame contains an indication of the length of the free cycle, including the following parameters:

Slot_length	States the length of each individual free slot.
Free_slots	States the total number of free slots in the current free cycle.
Rand_slots	States the interval for the random number generator in the MOB.
Max_access	States the maximum length of an <MRM>-frame, containing data or emergency, which can be sent without a preceding access request.
Max_speech	States the maximum length of a frame, containing a connection request, which can be sent without a preceding access request.

In order to reduce the probability of a collision between traffic from several mobile units, the free cycle is sub-divided into slots. The length of these slots (T1) are stated by the Slot_length parameter.

```
        |  slot n   |  slot n+1  |  slot n+2  |  slot n+3  |

-----|-----------|-----------|-----------|-----------|------> t
     t          t+T1      t+2*T1       t+3*T1     t+4*T1
```

By the aid of an internal clock, the mobile terminal is able to detect slot boundaries. The definition of how slot boundaries are calculated is found in reference R1-17.

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The following happens in the free slots.

1 Traffic initiated before the start of the free cycle must be distributed at random. A random number generator selects a slot between 1 and Rand_slots. Transmission begins at the start of the selected slot.

2 Traffic initiated during the free cycle is sent at the beginning of the next slot.

3 If the <MRM> to be sent is longer than MAX_ACCESS or MAX_SPEECH, a request for access must be made. The transmission of this request is done according to rules 1 or 2 above.

If the Data Link Layer is in the speech mode (ordered by the Network Layer), an <MRM> may be sent immediately. This is done independently of any free cycles.

4.2.2 Mobile fleet division

The access permission in the free cycle can be given to parts (subsets) of the mobile fleet according to the setting of corresponding fields in the free signal, <FRI>. This is used to reduce the number of access attempts in a free cycle. The following principles are used:

Masked addressing	The address and mask fields in <FRI> are used for a binary division (1, 2, 4, 8 etc) of the mobile fleet.
Priority	Is used to give access only to mobile terminals above a stated priority level.
Traffic type, FFG	Is used to give access only for stated traffic types (emergency, data or speech).

In the <SVP> a channel (receiving and transmitting frequencies) and a channel type (local system or access channel) can be given. By using the addressing facilities in the <SVP> it is possible to assign a certain system and/or access channel to the whole mobile fleet or to parts of it.

The local system channel is used in much the same way as any other system channel. It is not shared by surrounding base stations and may thus be used without interference from these.

When assigned a local system channel, the mobile terminal monitors this channel until further notice or the roaming algorithm indicates that it is no longer usable.

When assigned an access channel, the mobile terminal must use this channel when it has an <MRM> to transmit. The access rules described above also apply to this channel. After the <MRM> has been acknowledged the terminal returns to the previous (local) system channel.

4.3 ROAMING

The algorithm for selection of a suitable base is called roaming. It is designed to handle a nationwide system of base radio stations on different system channels, with either frequency or time division in their signalling. The algorithm includes two methods of channel monitoring: normal and quick.

A mobile terminal measures the received signal strength from all base radio stations. To evaluate one base station the mobile terminal calculates its roaming value. The roaming value is defined as the average received signal strength. Please see reference R1-17 for further information about how to measure received signal strength.

After a <BKT> or a <BKD> has been received, the monitoring is disabled. It is resumed after the connection/session is ended, and the same table of evaluations as before the connection is used.

When the terminal is switched on, it uses the CURRENT_SYSTEM_CHANNEL and the CURRENT_BASE until this base becomes unsuitable according to the roaming algorithm. If no CURRENT_BASE has been stored, the terminal immediately starts the quick channel monitoring, using the default list of system channels.

Lists of system channels

The mobile terminal uses a list of system channels when it monitors the base radio stations or searches for a new base. It is either a permanent or a temporary default list (please refer to the chapter 'SYSTEM PARAMETERS TO BE STORED IN THE TERMINAL' and to reference R1-06) or the current list (stated in the <SVP>-frame).

The default list is used until a <SVP>-frame has been received. A <SVP>-frame with a new list of system channels completely overrides the old current list.

The default list is also used in the quick channel monitoring after an unsuccessful search of the current list has been made. Again, the default list is used only until a valid <SVP>-frame with the current list of system channels has been received from the new base station.

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Nr No	Datum Date	Rev	Fil File
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Measurement methods

When the mobile terminal measures the received signal strength it can use two different measurement procedures: FRAME or CONTINUOUS. Which of these it should use is stated by the parameter RSSI_PROC in the <SVP>-frame.

If RSSI_PROC states FRAME the mobile terminal measures the received signal strength of the frame heads received during the RSSI_PERIOD (stated in <SVP>).

If RSSI_PROC states CONTINUOUS the mobile terminal measures the received signal strength during the entire RSSI_PERIOD.

The parameter RSSI_PERIOD includes channel switching time, and has the default value 2 960 ms, with a tolerance of +/- 10 ms.

During monitoring of current system channel and when making the final decision before chosing a new base, the terminal measures average received signal strength during the reception of frame heads.

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Normal channel monitoring

A mobile terminal measures the received signal strength from base radio stations on the CURRENT_SYSTEM_CHANNEL and calculates a roaming value for each base station.

During each <SVP>-cycle (i.e. the time between two <SVP>-frames) the terminal leaves the CURRENT_SYSTEM_CHANNEL for a predefined period to monitor other channels and then return. These channels are chosen from the list of system channels (default or current). The start of the scan period depends on the terminal's own subscription number (MAN) being odd or even:

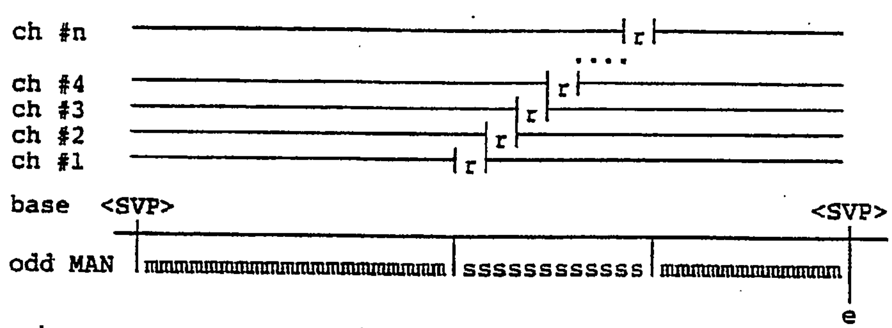
scan start(odd) = TIME_TO_NEXT - 10ms - 2*SCAN_TIME
scan start(even) = TIME_TO_NEXT - 10ms - SCAN_TIME

where

SCAN_TIME = Length of predefined scan period, including channel switching time. This is stated in the <SVP>-frame and has the default value 3 seconds, with a tolerance of +/- 10 ms..

TIME_TO_NEXT = Interval between two <SVP>-frames. This parameter is stated in the <SVP>-frame and has the default value 10 seconds.

Example:



where m = monitor current system channel
s = scan other system channels
r = RSSI_PERIOD
e = evaluation

The monitoring is cyclically repeated for all channels and every channel is monitored one RSSI_PERIOD.

For example, if the RSSI_PERIOD and SCAN_TIME have default values, the list contains 7 channels and the length of a <SVP>-cycle is 10 seconds, then the time between the scans of a specific channel from the list is 70 seconds. On the other hand, if the RSSI_PERIOD is 4 (80 ms) and SCAN_TIME is 30 (3 s) then the mobile will scan at least 30 channels during each <SVP>-cycle.

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Criteria for leaving CURRENT BASE

The mobile terminal leaves CURRENT_BASE during a <SVP>-cycle if:

-1- roaming value (CURRENT_BASE) < BAD_BASE

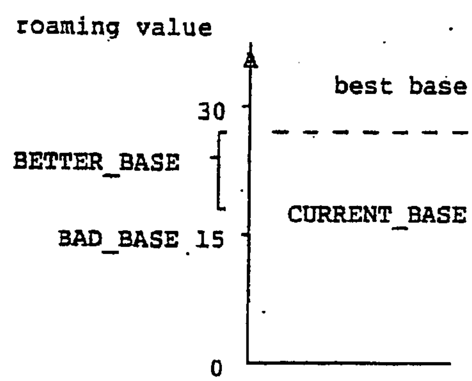
BAD_BASE is stated in the <SVP>-frame and its default value is 15.

or

-2- roaming value (best base) >
roaming value (CURRENT_BASE) + BETTER_BASE.

If this criterion is fulfilled, the mobile should remain in normal channel monitoring on the current system channel for another <SVP>-cycle. During the next scan period the mobile should measure the average received signal strength of frame heads from best base. If the roaming value still fulfils the criterion, the mobile should select this base as new CURRENT_BASE and the new channel as CURRENT_SYSTEM_CHANNEL.

The following figure shows an example where this criterion applies:



The parameter BETTER_BASE is stated in the <SVP>-frame and its default value is 10.

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The following criteria cause the mobile to leave CURRENT_BASE immediately without waiting for the end of the <SVP>-cycle:

-3- The terminal has made MAX_REP retransmissions without getting an acknowledgement from base. The value of MAX_REP is stated in the <SVP>-frame.

-4- The terminal has received a <NAT> (including an order to leave the CURRENT_BASE) from base.

And the last criterion applies when no traffic is exchanged:

-5- The terminal has not received valid <SVP>-frames within 2 <SVP>-cycles (= 2*TIME_TO_NEXT).

Any of the above criteria, except -2-, causes the mobile terminal to leave CURRENT_BASE and evaluate other bases.

Evaluation of other base stations

MOB first evaluates the best base (≠ CURRENT_BASE) from the normal channel monitoring. This is done by evaluating the:

- roaming value from the last <SVP>-cycle (on CURRENT_SYSTEM_CHANNEL)

- roaming value from the last RSSI_PERIOD of a specific channel (on the other system channels)

If the base is on the CURRENT_SYSTEM_CHANNEL and have a roaming value greater then GOOD_BASE it can be directly selected as CURRENT_BASE.

But if the new base is on a new system channel the mobile shall measure the average received signal strength during the reception of frame heads on this channel for SCAN_TIME. If the measured roaming value is greater then GOOD_BASE, the mobile should select this channel as CURRENT_SYSTEM_CHANNEL and this base as CURRENT_BASE.

Quick channel monitoring

If best base is not good enough, a quicker scanning procedure is adopted until a suitable base is found. MOB then scans its list of (current) system channels in the following way:

-1- Begin with the first channel from the list.

-2- Measure the average received signal strength for RSSI_PERIOD.

-3- If the measured roaming value is greater than GOOD_BASE remain on this channel. Otherwise skip to step 6.

-4- Measure the average received signal strength during the reception of frame heads on this channel for SCAN_TIME.

-5- If the roaming value is greater then GOOD_BASE select this channel as CURRENT_SYSTEM_CHANNEL, the base as CURRENT_BASE and return to normal channel monitoring. Otherwise go to step 6.

-6- Stop scanning if all channels of the list have been scanned. Otherwise choose next channel from list and repeat steps 2-5.

After MOB has scanned a number of channels from the list (please see reference R1-06) , or the list is ended, the current system channel is scanned in the same manner. The scan of the list is then resumed, if the end of the list was not already reached.

If the complete current list of system channels has been searched without a new base having been chosen, the quick channel monitoring is restarted with the default list of system channels.

Re-establishing contact

When a new CURRENT_BASE has been chosen, an <MRM>-frame with roaming information is sent to it. If the new BASE is identical to the old CURRENT_BASE, an <MRM>-frame with activation information is sent instead.

Area identification

The frame header (on the physical layer) includes an area identification used to specify geographical areas. Such an area is denoted as a traffic area and is given a unique area ID by the network.

From the network layer, the data link layer receives a list including the areas subscribed to by the user. The list also shows if the areas not subscribed to are allowed to be used, with for example higher charges, or not.

From the physical layer, the data link layer receives information about incoming roam information, i.e. area ID, base ID and weighted roaming value.

During the roaming procedure (described above), the terminal will primarily evaluate roaming information from bases belonging to the subscribed traffic areas. If the terminal is allowed to traffic other areas all bases may be considered in the roaming procedure.

In case a "non-subscribed" base is chosen (possible only in quick channel monitoring), it should be notified to the application layer, as well as when the terminal returns to a "subscribed" base.

If the terminal have not yet received the list of area IDs, the roaming procedure will evaluate all base stations.

4.4 ADDRESSING

4.4.1 Addressing the base radio station

The base radio station is only addressed in the frame head. Further details can be found in reference R1-17.

4.4.2 Addressing a mobile terminal

Transmitting — The mobile terminal's subscription number (MAN) is always used as the MOB address.

Receiving — When receiving, the MOB address refers to the mobile terminal's MAN, or any MAN representing a group to which the terminal belongs. (A transferred subscription is addressed in the MPAK.)

A MAN representing a group occurs only when receiving frame types <MRM>, <BKD>, <BKT>, <BBT> and together with a mask value of 0 in frame types <FRI>, <SVP>, <TST>. Masked addressing is described in detail in chapter 4.4.2.1.

Masked and priority addressing is used in frame types <SVP> and <TST>.

Masked, priority and traffic type addressing is used in frame type <FRI>.

4.4.2.1 Masked addressing.

Masked addressing is only used in <SVP>, <FRI> and <TST>. In this addressing mode both the MASK and MOB fields of the frame are used. The MASK field indicates the number of bits from the beginning of the MOB field (most significant bits) that should not be considered (masked out) when comparing the MOB field with the terminal's MAN.

A MASK value different from 0 (zero) indicates that only the terminal's own MAN is to be compared with the relevant bits of the MOB field.

A MASK value of 0 (no bits masked out, all bits of MOB are relevant) indicates that the MOB field is to be compared with both the terminal subscription MAN and with the MANs of all current group numbers in the group list.

The terminal is considered to be addressed if all relevant bits of the MOB field are the same as the corresponding bits of one of the compared MANs.

A MASK value of 24 (decimal) indicates that all bits are masked out and that all mobile terminals are addressed.

Note: For <SVP> and <TST> signals the priority of the terminal must also comply with that of the signal.

For the <FRI> signal the priority and traffic type of the terminal must comply with that of the signal for the terminal to be addressed (except for emergency where priority is ignored). (See below).

Example: Assume a frame with the following contents in the MOB and MASK fields.

(x indicates that the corresponding bit is to be ignored)

```
MOB field    Bit no. :          1                      24
             Value   :          101000000000101010110010

    MASK field   Bit no. :       1   5
                 Value   :       11000  (24 decimal)

        Addressed MAN Bit no.: 1                       24
                      Value  : xxxxxxxxxxxxxxxxxxxxxxxx

            All mobile terminals are addressed.

    MASK field   Bit no. :       1   5
                 Value   :       10111  (23 decimal)

        Addressed MAN Bit no.: 1                       24
                      Value  : xxxxxxxxxxxxxxxxxxxxxxx0

            Only mobile terminal subscriptions with MAN
            ending with binary 0 are addressed.

    MASK field   Bit no. :       1   5
                 Value   :       10110  (22 decimal)

        Addressed MAN Bit no.: 1                       24
                      Value  : xxxxxxxxxxxxxxxxxxxxxx10

            Only mobile terminal subscriptions with MAN
            ending with binary 10 are addressed.

    MASK field   Bit no. :       1   5
                 Value   :       00000  (0 decimal)

        Addressed MAN Bit no.: 1                       24
                      Value  : 101000000000101010110010
```

The MASK value 00000 (zero) indicates that mobile terminals with the terminal subscription MAN, or any of its MAN numbers representing groups, identical to the MOB field are addressed.

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4.4.2.2 Priority addressing

Priority addressing is used in the frames <SVP>, <TST> and <FRI>.

A terminal subscription belongs to one of 4 priority groups. The terminal may have two priority states within each group, normal or raised. The terminal will raise its priority if it has made MAX_REP retransmissions of the same frame without getting any acknowledgement from the base station.

PRIO	field	Meaning
7	111	Priority group 4, raised priority
6	110	" , normal
5	101	Priority group 3, raised priority
4	100	" , normal
3	011	Priority group 2, raised priority
2	010	" , normal
1	001	Priority group 1, raised priority
0	000	" , normal

When receiving a frame with priority addressing, the mobile terminal is addressed if its own priority is higher than or same as the received priority.

If the terminal is to transmit an emergency signal the priority level is ignored.

4.4.2.3 Traffic type addressing

Traffic type applies to the type of MPAK to be sent from the mobile terminal. The packets are separated into 3 traffic types:

emergency: MPAK class PSOSCOM

speech: MPAK class CSUBCOM

data: All other types of MPAK

Traffic type addressing is used only in the <FRI> frame. The traffic type to which the <FRI> applies is coded into the FFG field as follows:

Value	Emergency	Speech	Data
00	yes	no	no
01	yes	no	yes
10	yes	yes	no
11	yes	yes	yes

Note: For the frames <SVP> and <TST>, both the masked address and the priority must be correct for the terminal to be addressed.

For the <FRI> to be valid, the masked address, the priority and the traffic type criteria must be met by the terminal, except for the transmission of an emergency signal where only the masked address and traffic type criteria has to be met (priority is ignored).

4.5 **SEQUENTIAL NUMBERING**

The transmitting unit repeats the transmission of a frame if there is no response from the receiving unit. This means that the receiving unit can receive identical frames if its response is not detected by the transmitting unit. To avoid repeated presentation of information, certain types of frame are given sequential numbers. The principle is as follows.

- The terminal sets up a sequential register for the terminal subscription MAN (up and down sequential number) and for each of the MANs stored in GROUP_LIST (only a down sequential number for each).

- A sequential number is an integer with a value in the range (0...15). The sequential numbers are incremented cyclically 1, 2, 3...., 14, 1, 2, 3 etc. The values 0 and 15 are reserved for special purposes.

- The up sequential number applies to frames transmitted in the direction from MOB to BASE. The up sequential number is increased by one by the mobile terminal for each new <MRM>-frame transmitted.

- MOB which receives a sequentially numbered frame checks the sequential number of the frame against the stored down sequential number for the corresponding MAN. If the received sequential number is the same (and not 0, see below), the information in the frame is ignored. If the sequential number is not the same (or 0, see below), the frame is accepted and the sequential number of the received frame is stored (except for 15, se below). The number is stored when acknowledgement of the frame has been sent.

- On reception, the value 0 for a sequential number means that a sequential number check should not be carried out on the frame and that the value 0 should be stored in the terminal as the new down sequential number.

- On reception, the value 15 for a sequential number means that a sequential number check should not be carried out on the frame and that the old down sequential number remains.

The up and down sequential numbers are set to 0 when not defined (e.g. at initial start up).

Down sequential numbers for group numbers are reset to 0 when roaming in on a new base station.

Also returned packets with status UNKNOWN should have a sequential number.

When the mobile is transmitting the following types of packets, the sequential number 15 should be used:

```
CSUBCOM:DISCON
        CONREA
DTESERV:ACTIVE
        INACTIVE
        ROAM
        BORN
```

4.6 OUTPUT POWER CONTROL

The MOBITEX system allows for mobile terminals to control the output power via parameters in the system signalling, from the base radio station. Network operator requirements concerning this matter is stated in reference R1-06, as well as the nominal output power.

Requirements, such as the number of output levels to be controlled by the mobile terminal and in what steps the levels should be controlled, is also stated in reference R1-06.

The mobile terminal receives information about the output power to be used in the base station cell in question. This is stated by the parameter TXPOW in the <SVP>-frame.

Portable transmitters may have lower output power than ordinary transmitters. Note that the receiver sensitivity should be reduced or an offset should be added to the parameters GOOD_BASE and BAD_BASE used in the roaming procedure. This is done in order to keep the same ratio between the permitted transmission losses in the send and receive directions, i.e. to maintain a balanced radio path.

For example, if the power of the transmitter is 10 dB lower than the specified level, the receiver sensitivity could be reduced by 10 dB from the specified sensitivity level. Instead of reducing the sensitivity, an offset of 10 can be added to the parameters GOOD_BASE and BAD_BASE.

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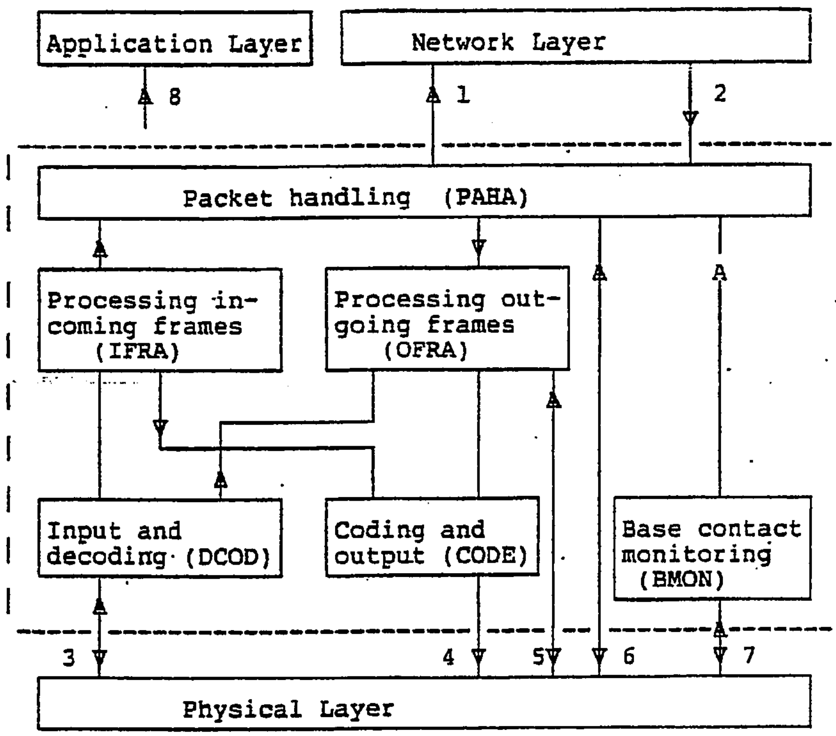
4.7 LOGICAL DESCRIPTION

The data flow diagram below shows the interaction between modules in the Data Link Layer and between this layer and the Network and Physical Layers.



-1- MPAK transmitted, MPAK not transmitted, MPAK received, roaming, activation
-2- MPAK to transmit, MPAK to retransmit, speech on, speech off, order to return MPAK, list of area IDs, list of group numbers

Signals to/from Physical Layer:

-3- Received block, Sync search
-4- Frame to send, Frame length
-5- Slot length, Chosen slot, Slot reached, Silence, Cannot send
-6- Current base, Frame sent
-7- Received base, Measure_RSSI, RSSI_measured

Signals to the Application Layer:

-8- Speech queue info, base lost, base contact, area subscribed to chosen, area not subscribed to chosen

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4.7.1 Input and decoding (DCOD)

DCOD converts the bit stream from the physical layer into frames. It decodes the blocks of these frames and checks that the frames are addressed to the terminal.

4.7.1.1 Logical description

```
LOOP
  wait for information bits from Physical Layer
  read and decode first block
  IF  first block is correct  THEN
    CASE  frame type
    WHEN  <ACK>,<NAK>,<ATL>,<ATD>,<ATT>,<NAT> or <VKT>
      IF  frame address = terminal address  THEN
        send frame to OFRA
      ENDIF
    WHEN  <REB>
      IF  frame address = terminal address  THEN
        read and decode remaining blocks of frame
        IF  frame is error-free  THEN
          send frame to OFRA
        ENDIF
      ENDIF
    WHEN  <FRI>, <SVP> or <TST>
      IF  (frame address with mask = terminal address) OR
          (mask=0 and address = a group address)  THEN
        read and decode remaining blocks of frame
        IF  frame is error-free  THEN
          send frame to OFRA
        ENDIF
      ENDIF
    WHEN  <AKT> or <RES>
      IF  frame address = terminal address  THEN
        read and decode remaining blocks of frame
        send frame to IFRA
      ENDIF
    WHEN  <MRM>, <BKD>, <BKT> or <BBT>
      IF  (frame address = terminal address) OR
          (frame address = a group address) THEN
        read and decode remaining blocks of frame
        send frame to IFRA
      ENDIF
    ENDCASE
  ENDIF
  send sync_search order to Physical Layer
ENDLOOP
```

4.7.2 Processing incoming frames (IFRA)

IFRA handles the received frames from DCOD. If a received <MRM> is not error-free, IFRA requests a repeat transmission of the faulty blocks until a correct <MRM> has been received and acknowledged.

4.7.2.1 Logical description

```
LOOP
  wait for frame from DCOD
  CASE  frame type
  WHEN  <MRM>
    IF  we have <MRM> waiting for <RES>  THEN
      delete that <MRM>
    ENDIF
    IF  response required  THEN
      IF  <MRM> is error-free  THEN
        create <ACK> and send it to CODE
        send <MRM> to PAHA
      ELSE
        IF  <MRM> is shorter than 3 blocks  THEN
          create <NAK> and send it to CODE
        ELSE
          create <REB> and send it to CODE
          store <MRM> while waiting for <RES>
        ENDIF
      ENDIF
    ELSE
      IF  <MRM> is error free  THEN
        send <MRM> to PAHA
      ENDIF
    ENDIF
  WHEN  <RES>
    retrieve stored  <MRM>
    IF  sequential number = stored <MRM>:s sequential
        number  THEN
      complete <MRM> with error free blocks from <RES>
      IF  <MRM> is error free  THEN
        create <ACK> and send it to CODE
        send <MRM> to PAHA
      ELSE
        create <REB> and send it to CODE
        store <MRM> while waiting for <RES>
      ENDIF
    ENDIF
  WHEN  <BKT>, <BKD> or <BBT>
    IF  frame is error free  THEN
      send frame to PAHA
    ENDIF
  WHEN  <AKT>
    create <ACK> and send it to CODE
  ENDCASE
ENDLOOP
```

4.7.3 Processing outgoing frames (OFRA)

OFRA handles the sending of frames. It must wait for permission to send, decide whether an access request is to be sent first etc.

OFRA receives <MRM>-frames of traffic types emergency, speech or data from PAHA. It returns them to PAHA with a statement of whether acknowledgement of the frame has been received or not. PAHA can also request that OFRA should cease trying to transfer the frame.

If the Data Link Layer is in speech_mode, an <MRM> may be sent immediately. This is done with a timeout that is independent of any free cycles.

OFRA is capable of handling only one <MRM>-frame at a time.

4.7.3.1 Logical description.

```
LOOP
  wait for input signal
  CASE input signal
  WHEN new <MRM> from PAHA
    IF (free cycle is running) and (priority and traffic
        type allows transmission) THEN
      choose next free slot
      store <MRM> while waiting for slot_reached
    ELSE
      IF speech_mode THEN
        send copy of <MRM> to CODE for transmission
        speech_mode_timer := 2 seconds
      ELSE
        store <MRM> while waiting for permission to send
      ENDIF
    ENDIF
    cancel_request := FALSE

  WHEN STOP_SEND from PAHA
    return <MRM> to PAHA with status 'discontinued'
    IF speech_queue THEN
      IF free cycle is running THEN
        choose next free slot
      ENDIF
      speech_queue   := FALSE
      cancel_request := TRUE
    ENDIF

  WHEN SPEECH_TRUE from PAHA
    speech_mode  := TRUE
    speech_queue := FALSE

  WHEN SPEECH_FALSE from PAHA
    speech_mode  := FALSE
```

```
WHEN  timeout of speech_mode_timer
  return <MRM> to PAHA with status 'failed'

WHEN  <ACK> from DCOD
  IF  sequential number in <ACK> = sequential number in
      latest <MRM>  THEN
    return <MRM> to PAHA with status 'OK'
    disable speech_mode_timer
  ENDIF

WHEN  <NAK> from DCOD
  IF  sequential number in <NAK> = sequential number in
      latest <MRM>  THEN
    send copy of latest <MRM> to CODE for transmission
  ENDIF

WHEN  <REB> from DCOD
  IF  sequential number in <REB> = sequential number in
      latest <MRM>  THEN
    create <RES> and send it to CODE for transmission
  ENDIF

WHEN  <FRI> from DCOD
  update free signal parameters
  IF  we have <MRM> waiting for <RES>  THEN
    delete that <MRM>
  ENDIF
  IF  cancel_request  THEN
    choose a random free slot
  ELSE
    IF  we have <MRM> to send  THEN
      IF  priority and traffic type allows transmission
      THEN
        IF  NOT speech_queue  THEN
          IF  we have already repeated <MRM> MAX_REP
              times  THEN
             return <MRM> to PAHA with status 'failed'
          ELSE
              choose a random free slot
              store <MRM> while waiting for slot_reached
          ENDIF
        ENDIF
      ELSE
        store <MRM> while waiting for permission to send
      ENDIF
    ENDIF
  ENDIF
```

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```
WHEN  <ATD> from DCOD
  IF  we have data <MRM> to send  THEN
    send copy of <MRM> to CODE for transmission
  ENDIF

WHEN  <ATT> from DCOD
  IF  we have speech <MRM> to send  THEN
    send copy of <MRM> to CODE for transmission
  ENDIF

WHEN  <NAT> from DCOD
  IF  we have speech <MRM> to send  THEN
    IF  order to leave CURRENT_BASE  THEN
      return <MRM> to PAHA with status 'failed'
    ELSE
      return <MRM> to PAHA with status 'no channel'
    ENDIF
  ENDIF
  speech_queue := FALSE

WHEN  <ATL> from DCOD
  IF  we have emergency <MRM> to send  THEN
    send copy of <MRM> to CODE for transmission
  ENDIF

WHEN  <SVP> from DCOD
  IF  (sub type 1 or 2) and (priority is the same as or
      less than terminal priority)  THEN
    send <SVP> to PAHA
  ENDIF

WHEN  <TST> from DCOD
  send signal to Physical Layer that we cannot_send in
  any slot

WHEN  <VKT> from DCOD
  speech_queue  := TRUE
  queue_timer   := timeout value
  send signal SPEECH_QUEUE_INFO to Application Layer

WHEN  timeout of queue_timer
  speech_queue := FALSE

WHEN  SILENCE from Physical Layer
  send signal to Physical Layer that we cannot_send in
  any slot
```

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```
WHEN  SLOT_REACHED from Physical Layer
  IF  we have <MRM> to send  THEN
    CASE  <MRM> traffic type
    WHEN  emergency
      IF  <MRM> contains more blocks than MAX_ACCESS
      THEN
        create <ABL> and send to CODE for transmission
      ELSE
        send copy of <MRM> to CODE for transmission
      ENDIF
    WHEN  speech
      IF  cancel_request  THEN
        cancel_request := FALSE
        create <AAT> and send to CODE for transmission
      ELSE
        IF  <MRM> with line connection request  THEN
          IF  <MRM> contains more blocks than MAX_SPEECH
          THEN
            create <ABT> and send to CODE for
            transmission
          ELSE
            send copy of <MRM> to CODE for transmission
          ENDIF
        ELSE
          send copy of <MRM> to CODE for transmission
        ENDIF
      ENDIF
    WHEN  data
      IF  <MRM> contains more blocks than MAX_ACCESS
      THEN
        create <ABD> and send to CODE for transmission
      ELSE
        send copy of <MRM> to CODE for transmission
      ENDIF
    ENDCASE
    increment counter of attempts to send
  ENDIF
 ENDCASE
ENDLOOP
```

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4.7.4 Coding and readout (CODE)

CODE codes the blocks of the frame and transfers the bits to the Physical Layer.

4.7.4.1 Logical description

```
LOOP
  Wait for frame to transmit
  Code the blocks of the frame
  Transfer the bits to the Physical Layer
ENDLOOP
```

4.7.5 Base contact monitoring (BMON)

BMON monitors contact with the base station(s) and works in 3 different modes:

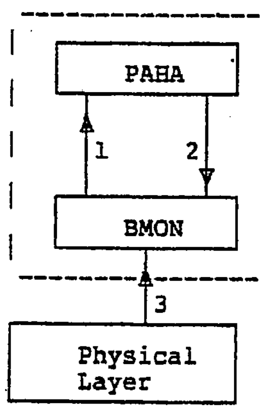
-1- Normal Channel Monitoring

-2- Quick Channel Monitoring

-3- Disabled

For further information, see chapter ROAMING.

Input signals come from the Physical Layer and from PAHA:



-1- no_base_contact
best_BASE

-2- set_mode_1
set_mode_2
set_mode_3

-3- received_base

4.7.6 Packet handling (PAHA)

PAHA handles the conversion between MPAKs and <MRM>-frames. It supervises the contact with BASE and informs the network when changing BASE and when returning after lost contact with the network.

PAHA is only capable of handling one MPAK at a time and it works in three different modes:

Normal mode - Contact with a base station is established and the Network Layer may send and receive all types of MPAK.

Speech mode - PAHA enters this mode only on order from the Network Layer. The Network Layer also decides which MPAKs that may be sent. PAHA leaves the speech mode on order from the Network Layer or when the transmission of an <MRM> has failed.

Base search mode - When base contact is lost, PAHA enters base search mode. MPAKs from the Network Layer are not handled in this mode. When a base has been located, PAHA returns to normal mode.

The mobile terminal returns to the relevant system channel after the end of all sessions on other channels (channel_for_sending_speech, channel_for_sending_data).

4.7.6.1 Logical description, main program

```
IF  an old base is saved  THEN
  send set_mode_1 to BMON
  system_channel  := current_system_channel
  OFRA_status     := free
  main_mode       := normal_mode
ELSE
  main_mode       := base_search_mode
ENDIF


LOOP
  CASE  main_mode
  WHEN  normal_mode
    normal
  WHEN  speech_mode
    speech
  WHEN  base_search_mode
    base_search
  ENDCASE
ENDLOOP
```

4.7.6.2 Logical description, normal (normal_mode)

```
WHILE  main_mode = normal_mode
  wait for input signal
  CASE  input signal

  WHEN  MPAK_TO_TRANSMIT from Network Layer
    create <MRM> with new up sequential number
    IF  access channel opened  THEN
      change to access channel
      channel := channel_for_sending_data
    ENDIF
    send <MRM> to OFRA
    OFRA_status := busy

  WHEN  MPAK_TO_RETRANSMIT from Network Layer
    create <MRM> with old up sequential number
    IF  access channel opened  THEN
      change to access channel
      channel := channel_for_sending_data
    ENDIF
    send <MRM> to OFRA
    OFRA_status := busy

  WHEN  SPEECH_ON from Network Layer
    main_mode := speech_mode

  WHEN  RETURN_MPAK from Network Layer
    send stop_send to OFRA
    wait to get frame that was in progress
    return <MRM> to Network Layer with status 'not
    transmitted'

  WHEN  <SVP> from OFRA
    CASE  sub type
    WHEN  1
      update parameters
    WHEN  2
      CASE  type of channel
      WHEN  local system channel opened
        system_channel := local
        change to new system channel
      WHEN  local system channel closed
        system_channel := previous
        change to new system channel
      WHEN  access channel opened
        store access channel
      WHEN  access channel closed
        delete access channel
      ENDCASE
    ENDCASE
```

```
WHEN  <BKT> from IFRA
  IF  acknowledgement of <MRM>  THEN
    send <ACK> to OFRA
  ELSE
    start timer with timeout value
  ENDIF
  channel := channel_for_speech
  change to designated channel
  send set_mode_3 to BMON

WHEN  <BKD> from IFRA
  IF  it is a channel change to send frame  THEN
    channel := channel_for_sending_data
  ELSE
    channel := channel_for_receiving_data
  ENDIF
  start timer with timeout value
  change to designated channel
  send set_mode_3 to BMON

WHEN  timeout for change of channel
  change to system_channel
  send set_mode_1 to BMON

WHEN  <BBT> from IFRA
  store new parameters and change channel

WHEN  <MRM> with status 'OK' from OFRA
  OFRA_status := free
  return MPAK to Network Layer with status 'transmitted'
  priority := normal
  IF  channel = channel_for_sending_data  THEN
    change to system_channel
    send set_mode_1 to BMON
  ENDIF
  reset timer for change of channel

WHEN  <MRM> with status 'failed' from OFRA
  OFRA_status := free
  return MPAK to Network Layer with status 'not
  transmitted'
  priority  := raised
  main_mode := base_search_mode
  reset timer for change of channel

WHEN  <MRM> with status 'no channel' from OFRA
  OFRA_status := free
  return MPAK to Network Layer with status 'not
  transmitted'
  priority  := raised
  reset timer for change of channel
```

```
WHEN  incoming <MRM> from IFRA
  CASE  incoming sequential number
  WHEN  0
    check_ok := TRUE
    store new down sequential number
  WHEN  15
    check_ok := TRUE
  WHEN  OTHERWISE
    IF  different from last seq. number received  THEN
      check_ok := TRUE
      store new down sequential number
    ELSE
      check_ok := FALSE
    ENDIF
  ENDCASE
  IF  check_ok  THEN
    IF  channel = channel_for_receiving_data  THEN
      IF  response NOT required  THEN
        change to system_channel
        send set_mode_1 to BMON
      ENDIF
    ENDIF
    send MPAK to Network Layer
  ELSE
    delete <MRM>
  ENDIF
  reset timer for change of channel

WHEN  Frame_sent from Physical Layer
  IF  frame = <ACK>  THEN
    IF  channel = channel_for_receiving_data  THEN
      change to system_channel
      send set_mode_1 to BMON
    ENDIF
    reset timer for change of channel
  ENDIF

WHEN  no_base_contact from BMON
  IF  OFRA_status = busy  THEN
    send stop_send to OFRA
    wait to get frame that was in progress
    return <MRM> to Network Layer with status 'not
    transmitted'
  ENDIF
  main_mode := base_search_mode

ENDCASE  input signal

ENDWHILE
```

4.7.6.3 Logical description, base search (base search mode)

```
wait for input signal BEST_BASE from BMON
IF  roaming value > GOOD_BASE  THEN
  CURRENT_BASE           := new base
  CURRENT_SYSTEM_CHANNEL := new channel
  send signal ROAMING to Network Layer
  clear sequential numbers for all groups
  delete access channel
ELSE
  send signal BASE_LOST to Application Layer
  send order set_mode_2 to BMON
  REPEAT
    wait for input signal BEST_BASE from BMON
  UNTIL  roaming value > CHOOSE_BASE
  IF  base = CURRENT_BASE  THEN
    send signal ACTIVATION to Network Layer
  ELSE
    CURRENT_BASE           := new base
    CURRENT_SYSTEM_CHANNEL := new channel
    send signal ROAMING to Network Layer
    clear sequential numbers for all groups
    delete access channel
  ENDIF
  send signal BASE_CONTACT to Application Layer
ENDIF
send set_mode_1 to BMON
main_mode := normal_mode
```

4.7.6.4 Logical description, speech (speech mode)

```
send speech_true to OFRA

WHILE  main_mode = speech_mode

  CASE  input signal
  WHEN  speech_off from Network Layer
    wait 0.5 seconds
    change to system_channel
    send set_mode_1 to BMON
    send speech_false to OFRA
    main_mode := normal_mode

  WHEN  new MPAK from Network Layer
    create <MRM> with new up sequential number
    send <MRM> to OFRA
    OFRA_status := busy

  WHEN  MPAK from Network Layer to be retransmitted
    create <MRM> with old up sequential number
    send <MRM> to OFRA
    OFRA_status := busy

  WHEN  <MRM> with status 'OK' from OFRA
    OFRA_status := free
    IF  <MRM> with CSUBCOM:DISCON  THEN
      change to system_channel
      send set_mode_1 to BMON
      send speech_false to OFRA
      main_mode := normal_mode
    ENDIF
    return MPAK to Network Layer with status 'transmitted'

  WHEN  <MRM> with status 'failed' from OFRA
    change to system_channel
    send set_mode_1 to BMON
    send speech_false to OFRA
    main_mode := normal_mode
    IF  <MRM> with CSUBCOM:DISCON  THEN
      send <MRM> to OFRA
    ELSE
      OFRA_status := free
      return MPAK to Network Layer with status 'not
      transmitted'
    ENDIF

  WHEN  <BBT> from IFRA
    store new parameters and change channel
```

```
WHEN  incoming <MRM> from IFRA
  CASE  incoming sequential number
  WHEN  0
    send MPAK to Network Layer
    store new down sequential number
  WHEN  15
    send MPAK to Network Layer
  WHEN  OTHERWISE
    IF  different from last seq. number received  THEN
      send MPAK to Network Layer
      store new down sequential number
    ELSE
      delete <MRM>
    ENDIF
  ENDCASE

WHEN  signal from BMON
  ignore this signal
ENDCASE

ENDWHILE
```

4.8 TRANSFER EXAMPLES

This chapter describes the most common transfer cases of the protocol.

4.8.1 Transfer without response

Transfer without response can only take place in the direction BASE to MOB.

In traffic to mobile terminal(s) BASE often addresses more than one MOB. This can apply to traffic to group numbers or frames where masked addressing occurs. In these cases MOB will not transmit a response. BASE states this by not setting the response flag in these frames.

Ex 1.1

```
Transfer without response, <MRM> BASE -->  MOB

BASE    <MRM>
MOB
        --------------------------------------------> t
```

4.8.2 Transfer with simple acknowledgement

BASE has full control over the down frequency and can transmit an <MRM>-frame at any time to a certain MOB. If the response flag is set and no incorrigible bit error has been detected in the frame, MOB should reply with <ACK>.

Ex 2.1

```
Transfer with response, <MRM>  BASE -->  MOB

BASE   <MRM>
MOB         <ACK>
     ----------------------------------------------> t
```

Note that <ACK> is sent without considering slot boundaries and other access limitations.

Ex 2.2

```
Transfer with response, <MRM>  MOB --->  BASE

BASE   <FRI>               <ACK>
MOB           <MRM>
     ----------------------------------------------> t
```

By transmitting <FRI>, BASE allows MOB to transmit <MRM>.

In this case MOB expects an acknowledgement from BASE. The lack of an acknowledgement is indicated in this case by MOB receiving a <FRI> without having previously received acknowledgement of its frame. Frame repetition follows in this case.

Free slots is defined, and thus access permission to the up channel is granted, when BASE transmits a <FRI> with an address that is applicable to MOB. Access permission is withdrawn for a certain MOB if any of the following cases arise.

1 BASE transmits a silence signal (see reference R1-17). This signal applies to all terminals.

2 BASE transmits a <TST> with an address which applies to MOB.

3 The free-cycle period as defined in the <FRI>-signal expires.

4.8.3 Transfer with block repetition

If the receiver of an <MRM> detects that one or more of the following blocks is incorrigible, the receiver may request repetition of these blocks with a <REB>. The sender replies with a <RES>.

NOTE Block repetition occurs only on <MRM>-frames where the number of blocks is 3 or more.

EX 3.1

```
Transfer with block repeat, MOB  --->  BASE

BASE            <REB>          <ACK>
MOB    <MRM>           <RES>
      -------------------------------------------> t
```

The principle described in the figure above applies in the direction to BASE and in the direction to MOB.

4.8.4 Transfer with frame repetition

Frame repetition can occur for three reasons:

1 The receiving unit transmits a <NAK>

2 The receiving unit does not transmit a response

3 The packet type results in frame repetition

EX 4.1

```
Transfer with negative acknowledgement MOB ---> BASE

BASE   < MRM >           <MRM>
MOB            <NAK>              <ACK>
     --------------------------------------------> t
```

If the receiving unit finds that the received frame is incorrectable and is less than 3 blocks, it can notify the sender unit by transmitting a <NAK>. The transmitting unit should then repeat the message. The principle above applies in both transmission directions.

The frame is repeated immediately after an <NAK> is received, regardless of slot boundaries.

Ex 4.2

```
Transfer with frame repeat,     MOB --->  BASE

BASE   <FRI>          <ACK>  <FRI>          <ACK>
MOB           <MRM>                 <MRM>
     ----------------xxxxx-----------------------> t
```

In this example the first acknowledgement from BASE is destroyed by interference so that MOB retransmits the same message after the next free signal.

Ex 4.3

```
Transfer with frame repeat,    BASE ---> MOB

BASE   < MRM >              <MRM>
MOB
       -------------------------------------------> t
```

In this example, frame repeat is caused by the packet type demanding repeated transmission. The response flag is never set in this case.

This case occurs for MPAK to group numbers. To avoid repeated presentation of the information in the frame, the frame has got a sequential number. According to the principles for sequential numbering, MOB will ignore subsequent identical frames.

NOTE! At the restart of a base radio station, the sequential numbers for all groups are set to 0. This is done to ensure that mobiles will not loose the first message to a group. The consequence of this action will be that the first message may be presented MAX_REP + 1 times at the mobile terminal.

4.8.5 Transfer with access request

If an <MRM>-frame to be sent from MOB to BASE is longer than MAX_ACCESS this <MRM> may not be sent during free slots. These longer frames are handled with access request, <ABD>, and access permission, <ATD>.

EX 5.1

```
Transfer with access request,  MOB  --->  BASE

BASE    <FRI>          <ATD>           <ACK>
MOB            <ABD>          <MRM>
      ------------------------------------------> t
```

The principle is that instead of MOB transmitting its <MRM>-frame, it transmits an <ABD>-frame. The reply to this request is an access permission, <ATD>. When MOB receives access permission, it immediately starts transmitting the <MRM>.

EX 5.2

```
Repetition with max_rep,  MOB  --->  BASE

BASE <FRI>      ..<FRI>      ....<FRI>|
MOB        <ABD>       <ABD>          |
                                     t1
      ------------------------------------------> t
```

t1: When the number of transmitted access requests is equal to MAX_REP+1 and another <FRI> is received, the MPAK is returned to the network layer and a new base is chosen.

4.8.6 Transfer with line connection

The line connection session is described in reference R1-09. When MOB wants to send an <MRM> (containing a request for a line connection) longer than MAX_SPEECH it must request access for this. The access request results in a channel change order. On the new channel the session for frames takes place to establish the line connection. When the line connection is concluded MOB returns to the system channel.

EX 6.1

```
 Transfer with line connection

BASE c1 <FRI>      <BKT>|                      |   |
BASE c2                 |<ATT>        <ACK>|   |
MOB  c1      <ABT>      |                      |   |
MOB  c2                 |         <MRM>        |...|
                        t1                    t2  t3
       ---------------------------------------------> t
```

t1: Disable roaming and start timeout with time from <BKT>.
t2: Stop timeout.
t3: Speech_on received from Network Layer.

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4.8.7 <u>Transfer on several channels</u>

Transfer on several channels can be divided into two separate cases:

1 MOB appears on another channel because BASE has stated in a <SVP>-frame that all traffic from a mobile terminal shall be sent on a channel other than that on which the <SVP> came.

2 BASE transmits a <BKD>-frame as a reply to an <ABD>.

EX 7.1

```
 Transfer on several channels

BASE c1 <FRI>      <BKD>|
BASE c2                 |<ATD>       <ACK>|
MOB  c1      <ABD>      |                 |
MOB  c2                 |      <MRM>      |
                        t1                t2
        ------------------------------------------> t
```

t1: Disable roaming and start timeout with time from <BKD>.
t2: Return to system_channel, enable roaming.

In this example, the access request from MOB resulted in a channel change order. The access permission is transmitted on channel c2. After having received an acknowledgement, MOB returns to channel c1.

4.8.8 <u>Line connection with hand over</u>

EX 8.1

```
 Ordinary line connection

BASE1,c1  <FRI>   <BKT>
BASE1,c2                <ATT>     <ACK>  |... speech
MOB,  c1        <ABT>                    |
MOB,  c2                   CONREQ        |... speech
                                         t1
     ------------------------------------------>t
```

t1: Ordinary connection established.

EX 8.2

```
 Continued with <BBT>

BASE2,c1          |      |                 |           |.....
BASE2,c3          |      |.. speech .      |     <ACK> |
BASE1,c1          |      |                 |           |
BASE1,c2 ....     |<BBT> |                 |           |
MOB,  c1          |      |                 |           |.....
MOB,  c2 ....     |      |                 |           |
MOB,  c3          |      |.. speech .      |DISCON     |
                 t2     t3                t4                 t5
     ------------------------------------------------------->t
```

t2: Hand over to base B2.
t3: MOB connected to base B2 on new speech channel, new system channel stored for later use.
t4: MOB breaks connection and changes to the new system channel.
t5: Connection ended.

4.8.9 Line connection with queue handling.

If no speech channel is immediately available, BASE may place MOB in a queue of callers and reply with <VKT>.

EX 9.1

```
 Succesfully established line connection

BASE1,c1 <FRI>    <VKT>|...|<BKT>                          |
BASE1,c2                   |   |       <ATT>       <ACK>   |speech
MOB,  c1       <ABT>       |...|                           |
MOB,  c2                   |   |           CONREQ          |speech
                           t1  t2                          t3
         ---------------------------------------------->t
```

t1-t2: Waiting time.
t3: Connection established.

EX 9.2

```
 Call attempt ended by BASE

BASE1,c1 <FRI>    <VKT>|...|<NAT>|
MOB,  c1       <ABT>   |...|     |
                       t1  t2    t3
         ------------------------------------------->t
```

t1-t2: Waiting time.
t3: Call attempt ended.

EX 9.3

```
 Call attempt ended by MOB

BASE1,c1 <FRI>    <VKT>|...|     |
MOB,  c1       <ABT>   |...|<AAT>|
                       t1  t2    t3
         ------------------------------------------->t
```

t1-t2: Waiting time.
t3: Call attempt ended.

EX 9.4

```
 Call attempt ended by MOB

BASE1,cl <FRI>    <VKT>|...|<VKT>|...|      |
MOB,  cl      <ABT>    |...|     |...|<AAT>|
                       t1  t2    t3  t4    t5
      ------------------------------------------->t
```

t1-t2: Waiting time.
t3-t4: Waiting time.
t5: Call attempt ended.

4.8.10 Line connection without access request

When MOB wants to send an <MRM> (containing a request for a line connection) shorter than or equal to MAX_SPEECH no access request is needed.

The response to the <MRM> is a channel change order that includes an acknowledgement. The line connection is immediately established on the new channel.

EX 10.1

```
 Line connection without access request

BASE c1 <FRI>    <BKT>
BASE c2                     .. speech ..
MOB  c1      <MRM>
MOB  c2                     .. speech ..
        -----------------------------------------> t
```

4.8.11 Ending a line connection

An <MRM> with a DISCON may be transmitted only once on the speech channel. If MOB have not received <ACK> within 2 seconds, it changes to the system channel and continues the transmission attempts according to the usual rules.

EX 11.1

```
 Ending a line connection

BASE c1                      |   |<FRI>      <ACK>|
BASE c2 ..speech.........|...|                    |
MOB  c1                      |   |      DISCON        |
MOB  c2 ..speech.. DISCON|...|                    |
                          t1  t2                 t3
        -----------------------------------------> t
```

t1-t2: Timeout.
t2: Return to system_channel, enable roaming.
t3: Connection ended.

4.8.12 Line connection ended by speech off

After the mobile terminal has received an <MRM> containing a line connection request, the session may be put to an end by the signal speech_off from the network layer. This signal is generated by a timeout (please see reference R1-09) when the operator has not answered the call.

EX 12.1

```
Connection ended by signal speech_off

BASE c1 <BKT>|                        |             |
BASE c2      |      <MRM>             |             |
MOB  c1      |                        |             |
MOB  c2      |              <ACK>|.........|
             t1                      t2            t3
          ------------------------------------------------> t
```

t1: Disable roaming and start timeout with time from <BKT>.
t2: Stop timeout.
t3: Speech_off received from Network Layer. Return to system channel and enable roaming.

5 SYSTEM PARAMETERS TO BE STORED IN THE TERMINAL

Certain system parameters are stored continuously (even if the terminal is powered off) in MOB to permit correct action when starting up. These are:

- The terminal subscription MAN
- Group number list (GROUP_LIST)
- Maximum number of retransmissions allowed (MAX_REP)
- Sequential numbers - terminal MAN (up/down)
- Current base
- Current system channel
- A list of the area identifications that the mobile is allowed to use. Please see reference R1-06.

When switched on, all these parameters apply until a frame is received containing the current parameter values.

There is also a permanent (and possibly a temporary) default list of system channels used by the roaming algorithm. They are stored continuously and have the following general format:

n(1-mmm)	total number of channels (2 bytes)
channel #1	system channels
:	
channel #n	

A channel is defined as a pair of frequencies and all the channels of this list are given in reference R1-06.

6 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 17, 22, 31, 62
R1-09, 4, 7, 55, 61
R1-17, 5, 14, 17, 24, 50

Below are the reference designations listed.

Reference	Section
R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05	References
R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

Uppgjord - Prepared: ET/SYS IK	Faktaansvarig - Subject responsible: ET/SYS IK	Nr - No: 91/1056 - A 296 5171/A2 Ue	
Dokansv Godkänd - Doc respons/approved: ET/SYSC STT STT		Datum - Date: 1990-02-22 Rev: A	File: MTS16A.2
Benämning: Cantel Mobitex		Titel - Title: MOBITEX Data Link Layer, Mobile Terminal Appendix A, Frames; 8/16 kbps	

ABSTRACT

This document describes frame structure and coding for the Data Link Layer.

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1 INTRODUCTION

1.1 GENERAL

The mobile terminal's Data Link Layer together with the Physical Layer form a radio protocol for communication between mobile stations (MOB) and a base radio station (BASE).

The interchange of information between BASE and MOB is in the form of frames. There are 21 different types of frames.

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2 FRAME TYPES

There are 21 different frame types:

	Name	Designation	Transmitted by BASE	Transmitted by MOB
1	M frame	<MRM>	Yes	Yes
2	Acknowledgement	<ACK>	Yes	Yes
3	Negative acknowledgement	<NAK>	Yes	Yes
4	Repetition request	<REB>	Yes	Yes
5	Repetition reply	<RES>	Yes	Yes
6	Access request, data	<ABD>	No	Yes
7	Access request, speech	<ABT>	No	Yes
8	Access request, emergency	<ABL>	No	Yes
9	Access permission, data	<ATD>	Yes	No
10	Access permission, speech	<ATT>	Yes	No
11	Access permission, emergency	<ATL>	Yes	No
12	Change channel, data	<BKD>	Yes	No
13	Change channel, speech	<BKT>	Yes	No
14	Free signal	<FRI>	Yes	No
15	Sweep signal	<SVP>	Yes	No
16	Silence order	<TST>	Yes	No
17	Activity request	<AKT>	Yes	No
18	No access permission, speech	<NAT>	Yes	No
19	Change base station, speech	<BBT>	Yes	No
20	Wait for channel,speech	<VKT>	Yes	No
21	Cancel access request, speech	<AAT>	No	Yes

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3 DESCRIPTION OF GENERAL FIELDS

In this chapter the general fields of a frame are described. Fields occuring only in specific frame types are described in conjunction with the definition of the respective frame type.

The fields are described in the following order:

1	MOB	address of mobile terminal, or group
2	TYPE	type of frame
3	BLOCK	number of blocks in the frame
4	PARITY	check sum
5	MASK	for masked addressing
6	PRIO	for priority addressing
7a	UPFREQ	frequency number, up frequency
7b	DOFREQ	frequency number, down frequency
8	NUMRET	number of retransmissions

The most significant bit lies to the left in the field, has the lowest order number and is sent and received first in time.

MOB 01 02 03 04 05 . . . 21 22 23 24

MOB

MOB states the address of the mobile unit concerned. This address refers to the terminals own subscription number, or to any number representing a group to which the terminal belongs.

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TYPE 01 02 03 04 05

TYPE

TYPE is bit 28-32 of the primary block and indicates the type of frame according to the following table:

Value		Type
Decimal	Binary	designation
01	00001	<MRM>
02	00010	<ACK>
03	00011	<NAK>
04	00100	<REB>
05	00101	<RES>
06	00110	<ABD>
07	00111	<ABT>
08	01000	<ABL>
09	01001	<ATD>
10	01010	<ATT>
11	01011	<ATL>
12	01100	<BKD>
13	01101	<BKT>
14	01110	<FRI>
15	01111	<SVP>
16	10000	<TST>
17	10001	<AKT>
18	10010	<NAT>
19	10011	<BBT>
20	10100	<VKT>
21	10101	<AAT>

BLOCK 01 02 03 04 05 06 07 08

BLOCK

States the number of blocks in the frame, including primary block.

PARITY 01 02 03 . . 14 15 16

PARITY

A frame comprises one or more blocks. A block comprises a source word and a coded parity word.

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```
MASK  01 02 03 04 05
     +--------------+
     |     MASK     |
     +--------------+
```

A group of terminals is addressed with masked addressing. The MASK states the number of most significant bits of the MOB address that should be ignored.

```
PRIO  01 02 03
     +--------+
     |  PRIO  |
     +--------+
```

PRIO		Meaning
7	111	Priority group 4, raised priority
6	110	" , normal
5	101	Priority group 3, raised priority
4	100	" , normal
3	011	Priority group 2, raised priority
2	010	" , normal
1	001	Priority group 1, raised priority
0	000	" , normal

```
UPFREQ 01 02 03 04          12 13 14 15 16
      +-----------------  -  ---------------+
      |         UPFREQ                      |
      +-----------------  -  ---------------+

      |<-FBI-->|<---- FREQ. NO. ------>|
DOFREQ 01 02 03 .   .   .   12 13 14 15 16
      +-----------  -  -  -  ---------------+
      |         DOFREQ                      |
      +-----------  -  -  -  ---------------+
```

States the frequency number, UPFREQ for transmit frequency and DOFREQ for receive frequency.

Bit 1 to 3 gives FBI (frequency band and bit rate INFORMATION) and bit 4 to 16 gives the frequency number. Both the parameters are defined in reference R1-06.

```
NUMRET 01 02 03 04 05 06 07 08
      +-----------------------+
      |        NUMRET         |
      +-----------------------+
```

States the number of retransmissions, including the current try.

4 FRAME TYPE DESCRIPTIONS

4.1 FRAME TYPE <MRM>, M-frame

APPLICATION An <MRM> is used to transfer packets. The packet format is defined in reference R1-09.

PRIMARY BLOCK

01 02 03 — 22 23 24	25	26 27	28	29	30	31	32
MOB	RE	OCTET	0	0	0	0	1

33 34 35 36	37 38 39 40	41 42 43 44 45 46 47 48
OCTET	SEQUENCE	BLOCK

49 50 51 52 53 54 — 144
INFO

145 — 160
PARITY

OCTET States the number of valid octets in the last following block. Remaining octets of the last block are filled with "0" to give a complete block. The field contains 6 bits and is used in the following way:

26 27 33 34 35 36
OCTET

SEQUENCE States the sequential number of the frame.

RE States whether a response is to be given to the frame. The mobile terminal shall always set this flag to "1" on transmission.

INFO Contains 12 octets of source data from the packet.

FOLLOWING BLOCK

APPLICATION The packet is placed in the following blocks with 18 octets from the packet in each. The number of valid octets in the last following block is indicated in the OCTET field of the primary block. The last following block is filled with "0" in the octets which do not belong to the packet.

01 02 03 04 05 06 ... 144
INFO

145 ... 160
PARITY

INFO Contains 18 octets of source data from the packet.

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4.2 FRAME TYPE <ACK>, Acknowledgement

APPLICATION — An <ACK> acknowledges a correctly received frame.

<ACK> indicates that all blocks in the frame have been correctly received. It includes the sequential number of the received frame.

PRIMARY BLOCK

01 02 03 — 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	0	0	1	0

33	34	35	36	37 38 39 40	41 42 43 44 45 46 47 48
0	0	0	0	SEQUENCE	BLOCK

49	50	51	52	53	54	—						144
0	0	0	0	0	0	—	0	0	0	0	0	0

145 — 160
PARITY

SEQUENCE — States the sequential number of the corresponding <MRM>-frame.

FOLLOWING BLOCK — No following blocks in this type of frame.

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4.3 FRAME TYPE <NAK>, Negative acknowledgement

APPLICATION

A <NAK> requests repetition of the entire <MRM>.

<NAK> indicates that the primary block has been correctly received, but that the following blocks have been lost. It contains the sequential number of the received primary block. <NAK> results in a complete repetition of the lost <MRM>.

Note that if the number of blocks in <MRM> was 3 or more, <REB> is used instead of <NAK>.

PRIMARY BLOCK

01 02 03 ... 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	0	0	1	1

33	34	35	36	37 38 39 40	41 42 43 44 45 46 47 48
0	0	0	0	SEQUENCE	BLOCK

49	50	51	52	53	54	...					144
0	0	0	0	0	0	0	0	0	0	0	0

145 ... 160
PARITY

SEQUENCE States the sequential number of the corresponding <MRM>-frame.

FOLLOWING BLOCK No following blocks in this type of frame.

4.4 FRAME TYPE <REB>, Repetition request

APPLICATION

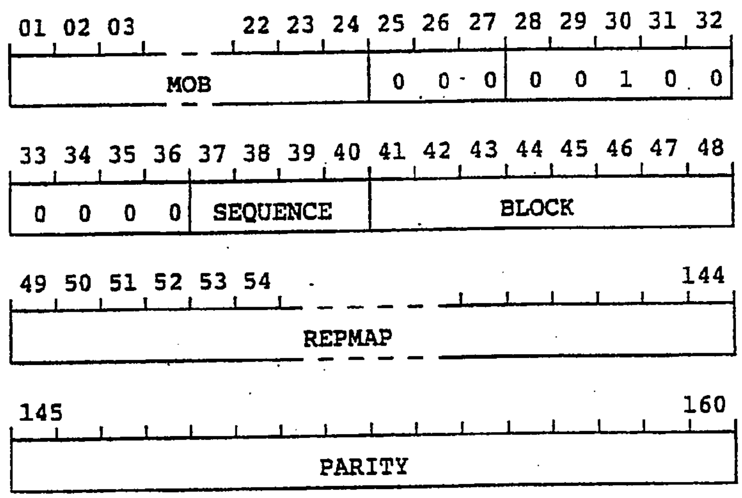
A <REB> requests repetition of erronous blocks in an <MRM>.

If it is found during reception that certain blocks in a frame cannot be corrected, a request for these blocks to be repeated can be made by transmitting a <REB>. The request contains a bit map of the blocks to be repeated. This bit map refers to the original <MRM>, even during a sequence of repetitions.

<REB> contains the sequential number of the received <MRM> primary block and results in a <RES>.

Note that if the number of blocks in <MRM> was 2 or less, <NAK> is used instead of <REB>.

PRIMARY BLOCK



SEQUENCE	States the sequential number of the corresponding <MRM>-frame.
REPMAP	Contains a bit map where each bit represents a block in the <MRM> previously received. A bit set to "1" indicates that the corresponding block is to be repeated. The bit in a REPMAP representing the primary block shall always have the value "0", since repetition of the primary block is illegal.
FOLLOWING BLOCK	No following blocks in this type of frame.

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4.5 FRAME TYPE <RES>, Repetition reply

APPLICATION A <RES> is the reply to a <REB>.

<RES> is a selective repetition of blocks from an <MRM>. The following blocks of the <RES> contain copies of blocks according to the bit map of the <REB>. <RES> contains the sequential number of the original <MRM>.

PRIMARY BLOCK

01 02 03 ... 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	0	1	0	1

33	34	35	36	37 38 39 40	41 42 43 44 45 46 47 48
0	0	0	0	SEQUENCE	BLOCK

49	50	51	52	53	54	...						144
0	0	0	0	0	0	...	0	0	0	0	0	0

145 ... 160
PARITY

SEQUENCE States the sequential number of the corresponding <MRM>-frame.

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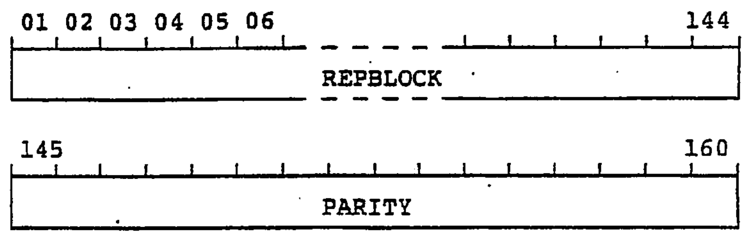
FOLLOWING BLOCK

APPLICATION — The following blocks contain copies of blocks according to the bit map of the <REB>. Only blocks requested to be repeated shall be packed into the following blocks. The order of the blocks is that stated in REPMAP.



REPBLOCK — The copy of a block from the original <MRM>-frame.

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4.6 FRAME TYPE <ABD>, Access request, data.

APPLICATION

An <ABD> is a request to transmit an <MRM> whose length (number of blocks) exceeds the value of MAX_ACCESS.

If the length of the <MRM> exceeds MAX_ACCESS, access must be requested before the <MRM> may be sent.

The <ABD> states the number of blocks in the corresponding <MRM>.

PRIMARY BLOCK

01 02 03 ... 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	0	1	1	0

33 34 35 36 37 38 39 40	41 42 43 44 45 46 47 48
BLOCK N	BLOCK

49 50 51 52 53 54 55 56	57	...			144
NUMRET	0	...	0	0	0

145 ... 160
PARITY

BLOCK N — States the number of blocks for which access is requested.

FOLLOWING BLOCK — No following blocks in this type of frame.

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4.7 FRAME TYPE <ABT>, Access request, speech

APPLICATION

An <ABT> is a request to transmit an <MRM> containing a request for a line connection, whose length (number of blocks) exceeds the value of MAX_SPEECH.

The <ABT> states the number of blocks in the corresponding <MRM>.

PRIMARY BLOCK

01 02 03 — 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	0	1	1	1

33 34 35 36 37 38 39 40	41 42 43 44 45 46 47 48
BLOCK N	BLOCK

49 50 51 52 53 54 55 56	57 — 144
NUMRET	0 — 0 0 0

145 — 160
PARITY

BLOCK N — States the number of blocks for which access is requested.

FOLLOWING BLOCK — No following blocks in this type of frame.

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4.8 FRAME TYPE <ABL>, Access request, emergency.

APPLICATION

An <ABL> is a request to transmit an <MRM> containing an emergency signal whose length exceeds the value of MAX_ACCESS.

If the length of the <MRM> exceeds MAX_ACCESS, access must be requested before the <MRM> may be sent.

The <ABL> states the number of blocks in the corresponding <MRM>.

PRIMARY BLOCK

01 02 03 — 22 23 24	25 26 27	28 29 30 31 32
MOB	0 0 0	0 1 0 0 0

33 34 35 36 37 38 39 40	41 42 43 44 45 46 47 48
BLOCK N	BLOCK

49 50 51 52 53 54 55 56	57 — 144
NUMRET	0 — 0 0 0

145 — 160
PARITY

BLOCK N — States the number of blocks for which access is requested.

FOLLOWING BLOCK — No following blocks in this type of frame.

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4.9 FRAME TYPE <ATD>, Access permission, data.

APPLICATION

BASE replies with an <ATD> to an <ABD> from a MOB, when BASE is ready to accept an <MRM>.

When permission is granted, MOB is expected to transmit an <MRM> containing a data packet.

PRIMARY BLOCK

01 02 03 ... 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	1	0	0	1

33	34	35	36	37	38	39	40	41 42 43 44 45 46 47 48
0	0	0	0	0	0	0	0	BLOCK

49	50	51	52	53	54	...						144
0	0	0	0	0	0	...	0	0	0	0	0	0

145 ... 160
PARITY

FOLLOWING BLOCK

No following blocks in this type of frame.

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4.10 FRAME TYPE <ATT>, Access permission, speech.

APPLICATION

BASE replies with an <ATT> to an <ABT> from a MOB, when BASE is ready to accept an <MRM>.

When permission is granted, MOB is expected to transmit an <MRM> containing a request for line connection.

PRIMARY BLOCK

01 02 03 – 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	1	0	1	0

33	34	35	36	37	38	39	40	41 42 43 44 45 46 47 48
0	0	0	0	0	0	0	0	BLOCK

49	50	51	52	53	54	– – –						144
0	0	0	0	0	0	– – –	0	0	0	0	0	0

145 – 160
PARITY

FOLLOWING BLOCK

No following blocks in this type of frame.

4.11 FRAME TYPE <ATL>, Access permission, emergency.

APPLICATION

BASE replies with an <ATL> to an <ABL> from a MOB, when BASE is ready to accept an <MRM>.

When permission is granted, MOB is expected to transmit an <MRM> containing an emergency signal.

PRIMARY BLOCK

01 02 03 — 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	1	0	1	1

33	34	35	36	37	38	39	40	41 42 43 44 45 46 47 48
0	0	0	0	0	0	0	0	BLOCK

49	50	51	52	53	54	—					144
0	0	0	0	0	0	—	0	0	0	0	0	0

145 — 160
PARITY

FOLLOWING BLOCK

No following blocks in this type of frame.

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4.12 FRAME TYPE <BKD>, Change channel, data.

APPLICATION

A <BKD> orders a MOB to another channel in order to transmit or receive an <MRM>.

The MOB usually returns to the original channel when the <MRM> has been transmitted or received. If an error occurs on the assigned channel then MOB returns to the original channel after a timeout period stated in the <BKD>.

PRIMARY BLOCK

01 02 03 ... 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	1	1	0	0

33	34	35	36	37	38	39	40	41 42 43 44 45 46 47 48
0	0	0	0	0	0	0	0	BLOCK

49 ... 64	65 ... 80	81 ... 96
BKDFL	UPFREQ	DOFREQ

97 ... 104	105 ... 144
TIMEOUT	0 0 ... 0 0 0 0 0

145 ... 160
PARITY

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BKDFL Indicates how the terminal is to act on the new channel.

Bit 1 Reserved
2 Reserved
3 Reserved
4 Change to send <MRM>
5 Change to receive <MRM>
6..16 Reserved

UPFREQ Frequency number for up frequency, i.e. the frequency on which the terminal transmits.

DOFREQ Frequency number of down frequency, i.e. the frequency on which BASE transmits.

TIMEOUT If error, return after TIMEOUT seconds (1-255).

FOLLOWING BLOCK No following blocks in this type of frame.

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4.13 FRAME TYPE <BKT>, Change channel, speech.

APPLICATION

A <BKT> orders a MOB to another channel in order to transmit or receive an <MRM> containing a request for line connection.

Normally the terminal returns to the original channel when the line connection is over. If an error occurs on the assigned channel then MOB returns to the original channel after a timeout period stated in the <BKT>.

PRIMARY BLOCK

01 02 03 ... 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	1	1	0	1

33	34	35	36	37 38 39 40	41 42 43 44 45 46 47 48
0	0	0	0	SEQUENCE	BLOCK

49 ... 64	65 ... 80	81 ... 96
BKTFL	UPFREQ	DOFREQ

97 ... 104	105 ... 144
TIMEOUT	0 0 ... 0 0 0 0 0

145 ... 160
PARITY

SEQUENCE Only valid if BKTFL bit 6 is TRUE.

BKTFL Indicates how the terminal is to act on the new channel.

Bit 1 Reserved
2 Reserved
3 Reserved
4 Change to send <MRM>
5 Change to receive <MRM>
6 Acknowledgement (including sequence number) of correctly received speech <MRM>. Ignore timeout.
7..16 Reserved

UPFREQ Frequency number for up frequency, i.e. the frequency on which the terminal transmits.

DOFREQ Frequency number of down frequency, i.e. the frequency on which BASE transmits.

TIMEOUT If error, return after TIMEOUT seconds (1-255).

FOLLOWING BLOCK No following blocks in this type of frame.

4.14 FRAME TYPE <FRI>, Free signal.

APPLICATION

BASE transmits a <FRI> when it is ready to handle traffic from MOB.

A free signal precedes a free cycle. A free cycle is a period of time when all of, or parts of, the total fleet of mobile terminals are collectively permitted to transmit.

PRIMARY BLOCK

01 02 03 – – 22 23 24	25	26 27	28	29	30	31	32
MOB	0	FFG	0	1	1	1	0

33 34 35	36 37 38 39 40	41 42 43 44 45 46 47 48
PRIO	MASK	BLOCK

49 50 51 52 53 54 55 56	57 58 59 60 61 62 63 64
RAND_SLOTS	FREE_SLOTS

65 66 67 68 69 70 71 72	73 74 75 76 77 78 79 80
MAX_ACCESS	SLOT_LENGTH

81 82 83 84 85 86 87 88	89	90	91	92	93	94	95	96
MAX_SPEECH	0	0	0	0	0	0	0	0

97	98	99				– – – –						144
0	0	0	0	0	0	– – – –	0	0	0	0	0	0

145 – 160
PARITY

FFG The FFG field states the type of traffic to which the free signal applies according to the following table.

Value	Emergency	Speech	Data
00	yes	no	no
01	yes	no	yes
10	yes	yes	no
11	yes	yes	yes

RAND_SLOTS The maximum number of the random number generator which selects in which slot the transmission shall start.

FREE_SLOTS The number of free slots in this free cycle.

MAX_ACCESS States the number of blocks which may be sent in an <MRM> without being preceeded by an access request.

SLOT_LENGTH Current value of slot_length.

MAX_SPEECH States the number of blocks which may be sent in a line connection request without being preceeded by an access request.

FOLLOWING BLOCK No following blocks in this type of frame.

4.15 FRAME TYPE <SVP>, Sweep signal

APPLICATION

The sweep signal is a periodically recurring signal from BASE. An <SVP> is transmitted by BASE for two reasons:

1 <SVP> marks the start of a sweep cycle.

2 <SVP> contains system parameters.

<SVP> has 2 different subtypes:

1 states the values of system parameters

2 states the frequency of different channel types

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<SVP>, SUBTYPE 1 - states the values of system parameters.

PRIMARY BLOCK

01	02	03	…	22	23	24	25	26	27	28	29	30	31	32
MOB							0	0	0	0	1	1	1	1

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
PRIO			MASK					BLOCK							

49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
SVPTYP								TXPOW							

65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
RSSI_PROC								RSSI_PERIOD							

81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
TIME_TO_NEXT								MAX_REP							

97–104	105–112
BASEST	SCAN_TIME

113–120	121–128
BAD_BASE	GOOD_BASE

129–136	137							144
BETTER_BASE	0	0	0	0	0	0	0	0

145–160
PARITY

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SVPTYP	States the <SVP> subtype, value 00000001 in this case.
TXPOW	States the decrease in output power (0-255 dB below nominal level) to be used by the mobile. A default value of 0 is used until this signal is received.
RSSI_PROC	States the method of the signal strength measurement: 0 = FRAME 1 = CONTINUOUS The default value is FRAME.
RSSI_PERIOD	Time used by the roaming algorithm (0-255 *20 ms). Default value: 148 (2 960 ms).
TIME_TO_NEXT	States the time in seconds to the next <SVP> frame. Default value: 10.
MAX_REP	States the value of the variable Max_rep.
BASEST	States status of base station.
SCAN_TIME	States the length of a period (0-255 *100 ms) when the terminal scans other system channels. Default value: 30 (3 seconds).
BAD_BASE	Used by the roaming algorithm. 0-255 dBuV. Default value: 15.
GOOD_BASE	Used by the roaming algorithm. 0-255 dBuV. Default value: 15.
BETTER_BASE	Used by the roaming algorithm. 0-255 dB. Default value: 10.

Most of the parameters above are further described in the MAIN DOCUMENT.

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FOLLOWING BLOCKS

If any, they contain a list of system channels to be used in base station monitoring. A frame with a list containing new system channels completely overrides the previous frame. The channel list has the following format (as described in the MAIN DOCUMENT):

FOLLOWING BLOCK #1

01 02 03 04 05 06 07 08	09	10	11	12	13	14	15	16
number of channels	0	0	0	0	0	0	0	0

17 ... 32	33 ... 48
channel #1 - UPFREQ	channel #1 - DOFREQ

49 ... 64	65 ... 80
channel #2 - UPFREQ	channel #2 - DOFREQ

81 ... 96	97 ... 112
channel #3 - UPFREQ	channel #3 - DOFREQ

113 ... 128	129 ... 144
channel #4 - UPFREQ	channel #4 - DOFREQ

145 ... 160
PARITY

The number of following blocks depends on the size of the list. The maximum number of channels in the list is stated in reference R1-06.

Continues with following block #2 on the next page.

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FOLLOWING BLOCK #2

01 – 16	17 – 32
channel #5 - UPFREQ	channel #5 - DOFREQ

33 – 48	49 – 64
channel #6 - UPFREQ	channel #6 - DOFREQ
. . .	. . .

129 – 144	145 – 160
channel #9 - UPFREQ	PARITY

FOLLOWING BLOCK #3

01 – 16	17 – 32
channel #9 - DOFREQ	channel #10 - UPFREQ

33 – 48	49 – 64
channel #10 - DOFREQ	channel #11 - UPFREQ

etc.

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<SVP>, SUBTYPE 2 - states the frequency of different channel types.

PRIMARY BLOCK

01 02 03 ... 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	0	1	1	1	1

33 34 35	36 37 38 39 40	41 42 43 44 45 46 47 48
PRIO	MASK	BLOCK

49 50 51 52 53 54 55 56	57 58 59 60 61 62 63 64
SVPTYP	CHATYP

65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
UPFREQ

81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96
DOFREQ

97 98 99 100 ... 144
0 0 0 0 0 0 ... 0 0 0 0 0 0

145 ... 160
PARITY

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SVPTYP	States the <SVP> subtype, value 00000010 in this case.
CHTYP	States the type of channel: Value: 1 Local system channel opened 2 Not used (ignore that order) 3 Local system channel closed (return to national system channel) 4 Access channel opened 5 Access channel closed
UPFREQ	Frequency number for up frequency, i.e. the frequency on which the terminal transmits.
DOFREQ	Frequency number for down frequency, i.e. the frequency on which BASE transmits.

FOLLOWING.BLOCK No following blocks in this type of frame.

4.16 FRAME TYPE <TST>, Silence order

APPLICATION

Silence order is used by BASE to withdraw all access permissions during a free cycle. A MOB that is already transmitting may continue to do so, but for every other MOB the access permissions for all traffic types (emergency, speech and data) are withdrawn.

Note: Please also refer to the description of the silence signal in reference R1-17. This signal has the same meaning as the <TST>-frame but uses only the frame head and thus addresses ALL mobile terminals.

PRIMARY BLOCK

01 02 03 ... 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	1	0	0	0	0

33 34 35	36 37 38 39 40	41 42 43 44 45 46 47 48
PRIO	MASK	BLOCK

49	50	51	52	53	54	...						144
0	0	0	0	0	0	...	0	0	0	0	0	0

145 ... 160
PARITY

FOLLOWING BLOCK

No following blocks in this type of frame.

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4.17 FRAME TYPE <AKT>, Activity request

APPLICATION An <AKT> is used by BASE to check whether a certain MOB is active. MOB replies with an <ACK> to such a frame.

PRIMARY BLOCK

01 02 03 ... 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	1	0	0	0	1

33	34	35	36	37	38	39	40	41 42 43 44 45 46 47 48
0	0	0	0	0	0	0	0	BLOCK

49	50	51	52	53	54	...						144
0	0	0	0	0	0	...	0	0	0	0	0	0

145 ... 160
PARITY

FOLLOWING BLOCK No following blocks in this type of frame.

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4.18 FRAME TYPE <NAT>, No access permission, speech

APPLICATION BASE replies with <NAT> to an <ABT> or a line connection request from a MOB when, for some reason, a line connection cannot be set up (e.g. no channel is available).

PRIMARY BLOCK

01 02 03 ... 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	1	0	0	1	0

33	34	35	36	37	38	39	40	41 42 43 44 45 46 47 48
0	0	0	0	0	0	0	0	BLOCK

49 50 51 52 53 54 55 56	57 ...	...	...	144
NATFL	0 ...	0	0	0

145 ... 160
PARITY

NATFL Contains the following orders:
Bit 49 Leave CURRENT_BASE.
50 - 56 Reserved

FOLLOWING BLOCK No following blocks in this type of frame.

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4.19 FRAME TYPE <BBT>, Change base station, speech.

APPLICATION BASE will use <BBT>
- as a response to an <ABT> when another base station is to be used for the line connection

or
- to hand over a call in progress to another base station.

PRIMARY BLOCK

01 02 03 – 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	1	0	0	1	1

33 34 35 36 37 38 39 40	41 42 43 44 45 46 47 48
TIMEOUT	BLOCK

49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64
BBTFL

65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
SPEECH UPFREQ

81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96
SPEECH DOFREQ

97 98 99 100 – 112
BASE

113 – 128
NEW SYSTEM UPFREQ

129 – 144
NEW SYSTEM DOFREQ

145 – 160
PARITY

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TIMEOUT	If error, return after TIMEOUT seconds (1-255).
BBTFL	Indicates the terminal is to act after changing to the new base station.

Bit 49	Reserved
50	Reserved
51	After the call, use BASE as new current base station.
52	After the call, return to old current base.
53	Change and start the call set_up procedure from the beginning (new <ABT> on BASE).
54	Change and continue (either signalling procedure or call in progress).
55-64	Reserved

BASE	The identity of the new base station to be used.
SPEECH UPFREQ	Frequency number for transmitting speech.
SPEECH DOFREQ	Frequency number for receiving speech.
NEW SYSTEM UPFREQ	Frequency number for upwards traffic on the new system channel, i.e. the frequency on which the terminal transmits.
NEW SYSTEM DOFREQ	Frequency number for downwards traffic on the new system channel, i.e. the frequency on which the terminal receives.
FOLLOWING BLOCK	No following blocks in this type of frame.

This order is only valid if both BBTFL 3 and BBTFL 6 are raised, i.e. hand over of a call in progress.

Other combinations of BBTFL are to be included in later versions.

4.20 FRAME TYPE <VKT>, Wait for channel, speech

APPLICATION BASE replies with one (or more) <VKT>-frame(s) to an <ABT> from a MOB when a speech channel is not immediately available.

PRIMARY BLOCK

01 02 03 — 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	1	0	1	0	0

33	34	35	36	37	38	39	40	41 42 43 44 45 46 47 48
0	0	0	0	0	0	0	0	BLOCK

49 50 51 52 53 54 55 56	57 58 59 60 61 62 63 64
TIMEOUT	QPOS

65	66	67	68	69	70	— — — —						144
0	0	0	0	0	0	— — — —	0	0	0	0	0	0

145 — 160
PARITY

TIMEOUT If the mobile terminal has not received a <BKT> or a <NAT> within TIMEOUT seconds (0-255), the <VKT> is invalidated.

QPOS States current position (1-255) in queue. It is recommended that this parameter is passed on to the application layer and shown to the operator.

FOLLOWING BLOCK No following blocks in this type of frame.

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4.21 FRAME TYPE <AAT>, Cancel access request, speech

APPLICATION MOB transmits an <AAT> when it wants to end a call and has been placed in a queue by BASE.

PRIMARY BLOCK

01 02 03 — 22 23 24	25	26	27	28	29	30	31	32
MOB	0	0	0	1	0	1	0	1

33	34	35	36	37	38	39	40	41 42 43 44 45 46 47 48
0	0	0	0	0	0	0	0	BLOCK

49	50	51	52	53	54	55	56	57	—			144
0	0	0	0	0	0	0	0	0	—	0	0	0

145 — 160
PARITY

FOLLOWING BLOCK No following blocks in this type of frame.

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5 CONVERTING A PACKET TO A FRAME

<MRM>-frames conveys MPAKs over the radio channel. The primary block can accomodate 12 and each following block 18 octets from the MPAK.

Frame head	
MOB address	Primary block with link layer information
Control field	
The first 12 octets of MPAK	
Parity field	
Next 18 octets of MPAK	Following block #1
Parity field	
Last octets of MPAK	Following block #n
Parity field	

When converting a packet to a frame, the first 12 octets in the packet shall be placed in the primary block of the frame. The last octets of the packet are placed in the last block. The primary block indicates how many octets in the last following block that are used. Unused octets in the last following block are filled with octets containing zeros.

In the primary block of the <MRM>-frame the Link Layer information is added. The MOB address field of the primary block shall always contain the MAN of the physical terminal concerned or, when the base station is transmitting to a group, the MAN of the addressed group. The base station identity is contained in the frame head preceding the primary block.

The addresses in the MPAK itself indicates the subscriptions concerned (terminal, transferable or group). For packets to/from the terminal itself or its group numbers, the MOB address field of the primary block and the address in the MPAK are the same. For packets to/from a transferred subscription, the corresponding addresses differ.

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6 BLOCK CODING

6.1 GENERAL DESCRIPTION

The code used is a cyclic block code for burst error control. The code message consists of 144 source data bits and a block check character (CRC, i.e. parity) of 16 bits, giving a total of 160 bits in a block.

The generator polynomial defining the code is

$$g(X) = X^{16} + X^{12} + X^5 + 1$$

i.e. CRC-CCITT X.25.

The CRC is initialized to all ones, calculated from all the 144 source data bits of the block and then its one's complement is transmitted.

This code detects all (single) error bursts up to 16 bits in length and about 99,998% of all other error patterns.

6.2 IMPLEMENTATION

CRC calculations are customarily done in a multi-section shift register which feeds into an exclusive-OR gate whose output feeds back to other XOR gates located in between the sections of the shift register. The placement and quantity of XOR gates are defined by the generator polynomial.

The CRC is then transmitted after the source data of the block.

A logical arrangement identical to that used in the transmitter is also used in the receiver. Again the CRC-register is initialized to all ones, the CRC is calculated from the 144 source bits and its one's complement is compared to the received CRC. If thes are different an error has been detected.

Instead of hardware logic a software algorithm may be used.

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7 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 7, 31
R1-09, 8
R1-17, 35

Below are the reference designations listed.

Reference	Section
R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05.	References
R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

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REQUIREMENT SPECIFICATION 1(16)

ET/SYS IK	ET/SYS IK	10/1056 - A 296 5171/02 Ue		
ET/SYSC STT STT		1990-02-26	A	MTS17.2
Cantel Mobitex™		MOBITEX Physical Layer, Mobile Terminal 8/16 kbps		

ABSTRACT

This document specifies the Physical Layer for mobile terminals connected to the MOBITEX network.

The exchange of information between base radio station and mobile is done by frames. A frame consists of a frame head and blocks.

The frame head is added to the message sent by the Data Link Layer to establish synchronisation and identify the base station. It also includes a set of control flags.

The blocks in a frame contain the data to/from the Data Link Layer plus parity bits for error correction.

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1 INTRODUCTION

1.1 GENERAL

The protocol in the Physical Layer describes the way the mobile terminal handles the radio channel. The logical structure of the protocol is described in this document, while hardware-related functions such as:

- method of modulation
- suitable equipment for implementation
- requirements for the equipment

are presented in reference R1-18.

2 THE CHANNEL

2.1 GENERAL CHARACTERISTICS

The channel between the base radio station and the mobile terminal uses

- separate frequencies for transmission and reception,
- synchronous communication and
- frequency modulation (FM).

It is also affected by

- varying field-strength,
- random errors and burst errors caused by fading and noise and
- bit errors caused by ignition interference.

Consideration has been given to these and other factors in the design of the protocol for the Physical Layer.

2.2 FRAME STRUCTURE

The exchange of information between base station and mobile is done by frames. A frame has the following structure:

Frame head	Block #1	Block #2	- - - -	Block #n

The frame head is a very important part of the frame. It is added to the message sent by the Data Link Layer to establish synchronisation and identify the base radio station.

The blocks in a frame contain the data to/from the Data Link Layer plus parity bits for error correction.

When the number of blocks is zero, i.e. when only a frame head is sent, the term "signal" is used.

3 THE FRAME HEAD

3.1 STRUCTURE

The frame head has the following structure:

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
BIT SYNCHRONISATION															

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
FRAME SYNCHRONISATION															

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
BASE IDENTITY						AREA IDENTITY						CTRL FLAGS			

49	50	51	52	53	54	55	56
PARITY BITS							

The different parts of the frame head are described in the following chapters.

3.2 SYNCHRONISATION

3.2.1 Bit synchronisation

This preamble is provided to enable bit sychronisation in the demodulator. It consists of 16 bits with the following pattern (bit #1 is sent first):

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	
1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	from BASE
0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	from MOB

3.2.2 Frame synchronisation

The frame synchronisation is provided to establish correct code word framing. Each network has its own pattern, used as network identification number, defined in reference R1-06. In order to roam into base radio stations in other networks, it should be possible to manually change the frame synchronisation word from the application layer.

It consists of 16 bits with the following structure, with bit #1 sent first:

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	from BASE
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	from MOB

If there is more than 1 bit error in the detected pattern, then frame sync is not established.

NOTE Only these 16 bits are used for frame synchronisation.

3.3 AREA IDENTITY, BASE IDENTITY AND CONTROL FLAGS

The base identity (6 bits) and the area identity (6 bits) together, states the unique identity of the base radio station concerned. The most significant bit (01) in the addresses is sent first.

The base identity is followed by four control flags. They are only used in traffic from BASE to MOB. The control flags are as follows (in order of reception):

1 SA_flag Reserved for future use.

2 Set_slot_flag 0 = FALSE
1 = TRUE, reset slot clock.

3 Roaming_flag 0 = FALSE
1 = TRUE, this is a roaming signal, i.e. it contains only a frame head.

4 Silence_flag 0 = FALSE
1 = TRUE, this is a silence signal, i.e. it contains only a frame head.

01 02 03 04 05 06	07 08 09 10 11 12	13 14 15 16
BASE IDENTITY	AREA IDENTITY	CTRL FLAGS
octet #1	octet #2	

parity #1	parity #2
PARITY	
17 18 19 20	21 22 23 24

The 8 (2*4) parity bits that follow the control flags are encoded in the same way as the blocks of the frame. Parity #1 is coded from octet #1 (see figure above) and parity #2 from octet #2.

The code corrects all single errors. In case the frame head could not be corrected, it should be rejected.

The parity bits may be ignored and the base identity and control flags read without any decoding.

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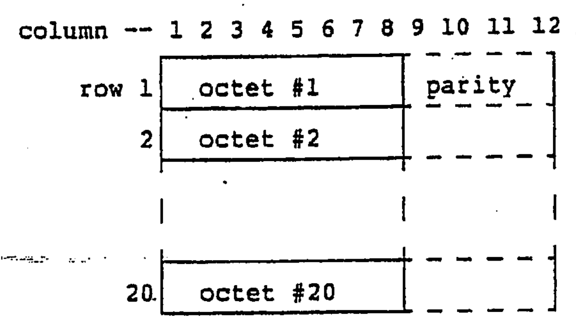
4 ERROR CORRECTION AND DETECTION

4.1 CODING

Each block to/from the Data Link Layer contains 20 octets of information. These are put into a matrix of the following format:



To each octet (column 1-8) four parity bits are added in the same row (9-12). These are encoded by a shortened (12,8) Hamming code.

The code corrects all single errors with hard decision decoding.

The code is defined by the following H-matrix:

$$H = \begin{bmatrix} 11101100 & 1000 \\ 11010011 & 0100 \\ 10111010 & 0010 \\ 01110101 & 0001 \end{bmatrix}$$

The syndrome (s) is calculated from the received code word (v) by

$$s=vH^T$$

where H^T denotes the transposed H-matrix.

The syndrome of a code word with a single error is equal to the columnvector of the H-matrix corresponding to the position of this error. The syndrome table is shown below.

syndrome	corresponds to a single error in bit position
0	-
1	0000 0000 0001
2	0000 0000 0010
3	-
4	0000 0000 0100
5	0000 0001 0000
6	0000 0010 0000
7	0001 0000 0000
8	0000 0000 1000
9	0000 0100 0000
10	0000 1000 0000
11	0010 0000 0000
12	-
13	0100 0000 0000
14	1000 0000 0000
15	-

If the syndrome is 0 the code word is correct.

The following examples illustrate the coding/decoding procedure:

transmitted info	transmitted parity	received info	received parity	syndrome
0000 0001	0101	0000 0001	0101	0000
0000 0101	1100	0101 0101	1100	1010
0000 0010	0110	0010 0010	0110	1011
0000 0101	1100	0000 1111	1100	1100

4.2 INTERLEAVING AND SCRAMBLING

Before transmission the code is interleaved to give protection against burst errors. The block-matrix is sent columnwise with start at position (1,1) and is received in the same way.

column --	1 2 3 4 5 6 7 8	9 10 11 12
row 1	octet #1	parity
2	octet #2	
20	octet #20	

The code without interleaving can correct single errors. The interleaved code can thus correct a burst of 20 errors, assuming that there is no other error in the same block.

<u>Scrambling</u>

At transmission and reception the bits following the frame head should be added modulo-2 (exclusive-ored) with the output from the ninth stage of a binary nine-stage shift register.

The outputs of the fifth and ninth stage of the shift register should be added modulo-2 and the result fed back to the input of the first stage.

All bits in the shift register should be sent to the logical value 1 upon initialization for reception or transmission.

That is, the bits following the frame head will be exclusive-ored with the sequence:

111111111000001111011111000101...., etc.

This scrambling sequence is the recomended test sequence described in CCITT recommendation V.52, as well as the shift register on the next page.

<u>Note:</u> It should be possible, via a test command in MASC (reference R1-19), to order the mobile to start/stop sending the above described scrambling sequence. This should only be possible during test, <u>not</u> during normal operation.

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Shift register stages during pseudo-random pattern generation.

1	2	3	4	5	6	7	8	9	Out
1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1
0	0	1	1	1	1	1	1	1	1
0	0	0	1	1	1	1	1	1	1
0	0	0	0	1	1	1	1	1	1
0	0	0	0	0	1	1	1	1	1
1	0	0	0	0	0	1	1	1	1
1	1	0	0	0	0	0	1	1	1
1	1	1	0	0	0	0	0	1	1
1	1	1	1	0	0	0	0	0	0
0	1	1	1	1	0	0	0	0	0
1	0	1	1	1	1	0	0	0	0
1	1	0	1	1	1	1	0	0	0
1	1	1	0	1	1	1	1	0	0
1	1	1	1	0	1	1	1	1	1

5 TIME DIVISION

The time axis is divided into slots. The length (L) of one of these slots is given by the parameter Slot_length.

```
 -  ------------------------------------------------------------  -
   | slot n         | slot n+1       | slot n+2       | slot n+3       |
 -  ------------------------------------------------------------  -
---+----------------+----------------+----------------+----------------+------>time
   t               t+L             t+2L             t+3L             t+4L
```

The mobile keeps a clock going to be able to detect slot boundaries. The start (t1) of the first slot in a sequence is defined by BASE transmitting a frame head with a Set_slot_flag.

```
 -  ---------------------------   - -
   | frame head | block #1    |
 -  ---------------------------   - -
--+-------------------------+-----------------------------> time
  t0                         t1 = t0 + 20 ms
```

The first bit of the frame head is received at time t0. Slot number n starts at:

    t = t1 + (n-1)*L

where

    L = Slot_length * (32/bitrate) seconds
    n = 1..x

The tolerance for determining the start of a slot is -0.1/+3 ms.

6 TRANSMISSION

When an order to transmit a frame (FRAME_TO_SEND) has come from the Data Link Layer, the Physical Layer first waits until the slot clock reaches the CHOSEN_SLOT (please also refer to chapter 8) before it:

- indicates SLOT_REACHED to the Data Link Layer
- switches the carrier on
- waits until carrier frequency and power has stabilized
- waits 5 ms (tolerance -0/+5 ms)
- sends frame head with base and area identity (from Current_base) and all control flags = 0 (i.e. FALSE)
- encodes and sends all blocks of the frame

before it switches the carrier off and indicates FRAME_SENT to the Data Link Layer. If the order CANNOT_SEND comes from the Data Link Layer before the CHOSEN_SLOT is reached, then the transmission will not be started.

7 RECEPTION

The following takes place when correct bit and frame synchronisation has been established:

```
get average signal strength during reception of
  frame head *)
send Received_base to Data Link Layer
IF  received base = Current_base  THEN
  IF  Silence_flag  THEN
    send Silence to Data Link Layer
  ELSE
    IF  Set_slot_flag  THEN
      reset slot clock
    ENDIF
    REPEAT
      read block
      decode block
      send Received_block to Data Link Layer
    UNTIL  Sync_search
  ENDIF
ENDIF
```

On reception of the order Measure_RSSI from the Data Link Layer, the average signal strength *) is measured during the time stated in the order. Thereafter an answer, RSSI_measured, is sent to the Data Link Layer.

*) The RSSI should be sampled with a frequency of 1000 samples per second.

8 INTERFACE TO THE DATA LINK LAYER

Parameters received from the Data Link Layer:

Slot_length	- states the length of a single slot. The unit is (32/bitrate) seconds.
Chosen_slot	- states the slot where transmission starts.
Current_base	- states which base radio station is currently used (base and area identity).
Frame_to_send	- is a message consisting of at least one block.
Frame_length	- states the number of blocks in message.
Sync_search	- orders the Physical Layer to stop reading and enter sync search mode.
Cannot_send	- orders the Physical Layer not to send in any slot.
Measure_RSSI	- orders the Physical Layer to measure the average received signal strength, during the time stated in the order.

Parameters sent to the Data Link Layer:

Frame_sent	- indicates that a frame transmission is completed.
Received_block	- is a decoded block (w error indication).
Received_base	- states the base identity, area identity and the received signal strength in dBuV.
Silence	- indicates that we have received a silence signal.
Slot_reached	- indicates the start of the Chosen_slot.
RSSI_Measured	- the average received signal strength, during in order Measure_RSSI stated time.

9 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 6
R1-18, 3
R1-19, 10

Below are the reference designations listed.

Reference	Section
R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05	References
R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

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		REQUIREMENT SPECIFICATION	1(21)
Uppgjord Prepared: ET/UC SIS	Faktaansvarig Subject responsible: ET/UC SIS	Nr No: 1056 - A 296 5173/04 Ue	
Dokansv/Godkänd - Doc respons approved: ET/SYSC STT		Datum Date: 1990-02-25 Rev: A	Fil File: MTS18.2
Benämning: Cantel Mobitex		MOBITEX Mobile radio equipment 8 kbit/s, 12.5 kHz channel spacing	

ABSTRACT

This document specifies the requirements for the radio transmitter and receiver in the MOBITEX MOBILE TERMINAL.

The document contains a functional description and a detailed specification of the technical requirements and performance of the transmitter and receiver.

The equipment specified in this document should also meet with basic requirements set up in national regulations for radio transmitters and radio receivers.

Environmental, power supply and operational control requirements are found in the document General Requirements for the Mobile Terminal.

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1 INTRODUCTION

1.1 GENERAL

The radio transceiver serves as interface between the radio path and the logic and control unit of the mobile terminal. Data and voice transmission is provided.

The transmission mode is semi-duplex, the base station operates in full duplex mode and the mobile station in two frequency simplex mode.

Digital FM modulation is used for data transmission at a speed of 8 kbit/s.

The channel spacing is 12.5 kHz.

2 FUNCTIONAL DESCRIPTION

2.1 DATA TRANSMISSION

The main traffic in the Mobitex network will be of the data transmission type.

A modulation type which makes it possible to utilize the radio transceiver for speech transmission as well as for data transmission has been chosen.

The modulation type is binary digital baseband filtered FM at a speed of 8 kbit/s.

There should be no squelch function during data transmissions.

During data transmissions the audio paths for speech transmissions to be muted.

The data transmission mode is used for transmission of system information, system orders and for the signalling between the base station and the mobile station as well as for the user data and text transmissions.

The data transmission mode is basically a simplex mode, data transmission takes place only in one direction at a time. Short switchover times are important as this will increase the system efficiency.

2.2 SPEECH TRANSMISSION

The speech transmission mode is only reached after a request from either a mobile or a fixed terminal.

After a request for speech communication the base station allocates a radio channel and sends an order to the mobile station to switch over to that channel (separate transmit and receive frequencies).

No squelch function is to be used during speech communication.

The muting of the audio paths is released during speech communication. If, however, a data signal is detected during the speech, the audio paths to be muted immediately. This will for example occur when a data message is received during ongoing speech conversation.

2.3 TRANSMITTER CONTROL

2.3.1 Frequency

The transmitter frequency is controlled by the control unit.

For information about frequency band and channel numbering plan to be used, please refer to document R1-06.

2.3.2 Carrier

The carrier on/off condition is controlled by the control unit during data transmissions. During speech transmission the carrier on/off condition is controlled by the manually operated transmit/receive switch.

Requirements of dynamic output power control can be made. In such a case, these are stated in reference R1-06.

There is to be a control circuit, independent of all other logic, which prohibits the continuous transmission of carrier for longer periods than 10 minutes.

2.3.3 Audio muting

The voice signal to the transmitter to be muted during data transmissions.

2.4 RECEIVER CONTROL

2.4.1 Frequency

The receiver frequency is controlled by the control unit.

For information about frequency band and channel numbering plan to be used, please refer to document R1-06.

2.4.2 Squelch control

There must be no squelch function in the receiver.

2.4.3 Signal strength indication

The received signal strength level is used in the roaming algorithm for selection of base station.
Please refer to chapter RECEIVER in this document which includes a specification of the signal strength indication.

2.4.4 Audio muting

Whenever a data signal is detected, e.g detection of frame synchronization, the receiver voice output should be muted.

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3 PERFORMANCE AND TECHNICAL REQUIREMENTS

3.1 GENERAL

For definitions and measurement methods, please refer to Appendix A.

3.1.1 Frequency range

For information about which frequency band and channel numbering plan etc that will be used, please refer to document R1-06.

3.1.2 Frequency error

The frequency error ~~of~~ the transmitter and receiver shall not exceed (+)(-) 1.5 ppm.

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3.1.3 Data transmission

3.1.3.1 Modulator

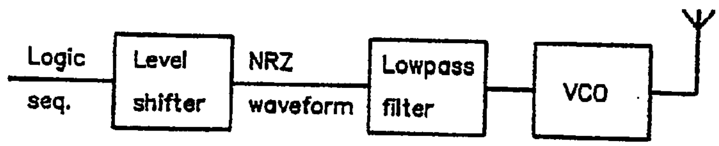

Figure 1. Block diagram of the method of modulation.

The modulation type is binary digital baseband filtered FM at a speed of 8 kbit/s. The method of modulation is shown in principle in Figure 1. The logic sequence to transmit is converted to a binary NRZ waveform by a level shifter and the NRZ waveform is filtered by a lowpass filter with linear phase characteristic.

The filtered waveform is applied as control input to a VCO, a voltage controlled oscillator. The lowpass filter reduces the deviation of the modulator for the high-frequency components of the binary modulating signal and thereby reduces the out of band emission of the transmitter.

A sequence of logic 1's should yield a transmitter frequency 2.0 kHz higher than the channel center frequency. A sequence of logic 0's should yield a transmitter frequency 2.0 kHz lower than the channel center frequency. That is the modulation index is 0.5.

The filter (or the equivalent filter in case of an other implementation) shall be a low pass filter with linear phase characteristic and a 3-dB frequency of 2.4 kHz. At a frequency two (2) times the 3-dB frequency the attenuation of the filter shall be 12 dB, and at a frequency four (4) times the 3-dB frequency the attenuation of the filter shall be 48 dB. The high frequency roll-off of the filter must be at least 40 dB/octave. A high frequency attenuation of 70 dB is considered sufficient. Figure 2 shows the amplitude response of the filter. The frequency modulator should be of a wide band linear type with frequency independent response in the frequency range 0 - 4 kHz or otherwise compensated in the baseband filter. An eye diagram of the transmitted signal is shown in Figure 3.

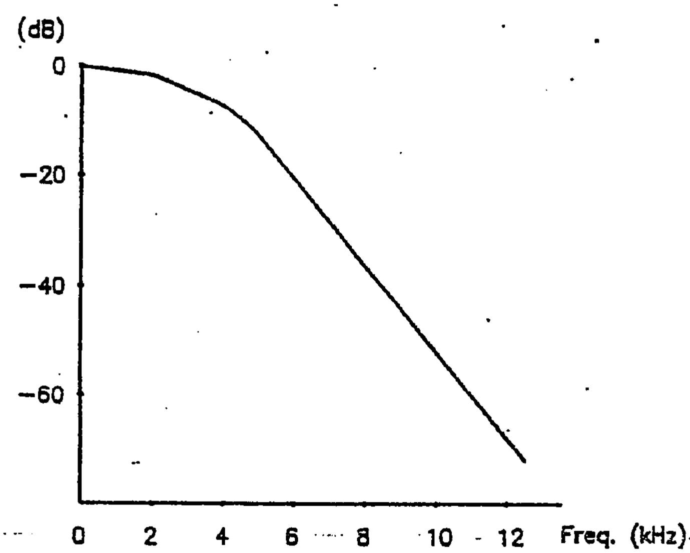

Figure 2. Amplitude response of lowpass filter.

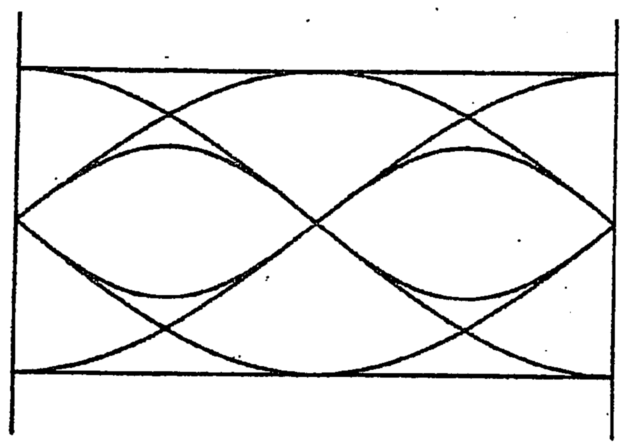

Figure 3. Eye diagram.

A preferred implementation of the baseband processing is oversampling of the bit-stream 4 - 8 times and digital filtering in a FIR (finite impulse response) filter with symmetric coefficients. This type of implementation can be realized by simple table look-up in a PROM.

The modulation rate is 8 kbits per second. The frequency error of the bitrate clock should not exceed +-10 ppm. The error of the modulation index should not exceed +- 5 %.

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3.1.3.2 Demodulator

The demodulator should be of non-coherent type. A simple decision feedback or sequence detector should be used to resolve the small receiver eye opening of two subsequent bit transitions. A required bit error rate (BER) curve as a function of receiver input in a static receiver noise limited situation is shown in Figure 4.

The performance requirement of the complete receiving equipment when connected to a reference data transmitter is that the decoded block error rate should be less than 0.1 at the reference RF input signal level. At an RF input signal level 30 dB above the the reference level, the decoded block error rate should be less than 0.0001.

It is essential that the demodulator keeps the synchronism with the incoming bit-stream during an entire message, even under disturbed conditions, in order to avoid repetition of other blocks than those which were actually disturbed.

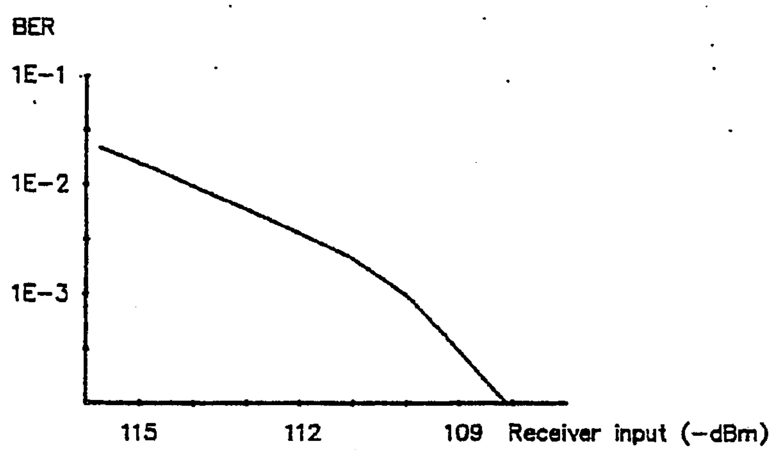

Figure 4. Bit error rate versus receiver input level.

3.1.3.3 Start of data modulation

Data modulation must not start until the carrier frequency is within its 200 Hz from its steady state value and the carrier power is within 2 dB from its steady state value.

The transmitter carrier should be on for 5 -0/+5 ms before the start of transmission (frame head).

3.1.3.4 Receive/transmit switching times

The switching time from receive to transmit condition to be less than 20 ms including CPU handling time.

The switching.time from transmit to receive condition to be less than 20 ms including CPU handling time.

3.1.4 Test terminals

Please note that the transceiver input/output terminals for voice must be accessible.

An interface according to the "machine interface" defined in reference R1-19, must be available during testing.

3.1.5 Test modulation

Short and long frames as defined in the link layer will be used during tests of data transmission.

It should be possible to force the modem to continuously transmit a sequence as specified in the national requirements for out of band emission testing.

It should be also be possible to force the modem to continuously transmit the scrambling sequence that is specified in Physical Layer Specification of the mobile terminal.

Normal audio test modulation is a 1 kHz test tone at such a level that the resulting deviation is +- 1.5 kHz.

3.2 TRANSMITTER

For definitions and measurement methods, please refer to Appendix A.

3.2.1 Carrier power

The nominal output power is stated in reference R1-06. Requirements of dynamic output power control can be made. In such a case, these are also stated in reference R1-06.

Under normal test conditions and independent of selected channel the carrier output power during carrier on condition to be within (+)(-) 1,5 dB of the nominal output power. Under extreme test conditions the carrier output power to be within +2 dB and -3 dB of the nominal output power.

When the transmitter is in the carrier off condition, the carrier output power should not exceed 0,25uW.

The transmitter to be able to withstand load tests as described below:

- the change in the transmitter output power should not exceed 2 dB during a load test when the transmitter is loaded with a resistive load giving a standing wave ratio of 2. The test to be done at normal test conditions during 5 minutes of continuous transmission.

- without being damaged the transmitter should be able to withstand the same test at extreme test conditions.

- without being damaged the transmitter should be able to transmit for a period of 1 minute with the antenna terminal left open.

- the last mentioned test to be repeated with the antenna terminal short-circuit.

3.2.2 Carrier rise and fall time

The carrier rise time and carrier fall time are included in the transmit-receive and receive-transmit switching times. Please refer to chapter "Receive/transmit switching times" in this document.

3.2.3 Channel switching time

The channel switching time should not exceed 30 ms.

3.2.4 Frequency deviation

3.2.4.1 Maximum permissible deviation

The maximum permissible frequency deviation to be (+)(-)2.5 kHz.

3.2.4.2 Data modulation

A long sequence of logic 1's (0's) should produce a carrier frequency deviation of +(-, for 0's) 2.0 kHz +- 0.1 kHz.

3.2.4.3 Audio modulation

The normal audio test tone will produce a deviation of +- 1.5 kHz.

3.2.4.4 Audio frequency response

The audio frequency response, measured through the audio signal input terminal, should have a 6 dB/octave pre-emphasis between 300 Hz to 2500 Hz. For frequencies higher than 3000 Hz, the frequency response should have a roll-off of at least 30 dB/octave.

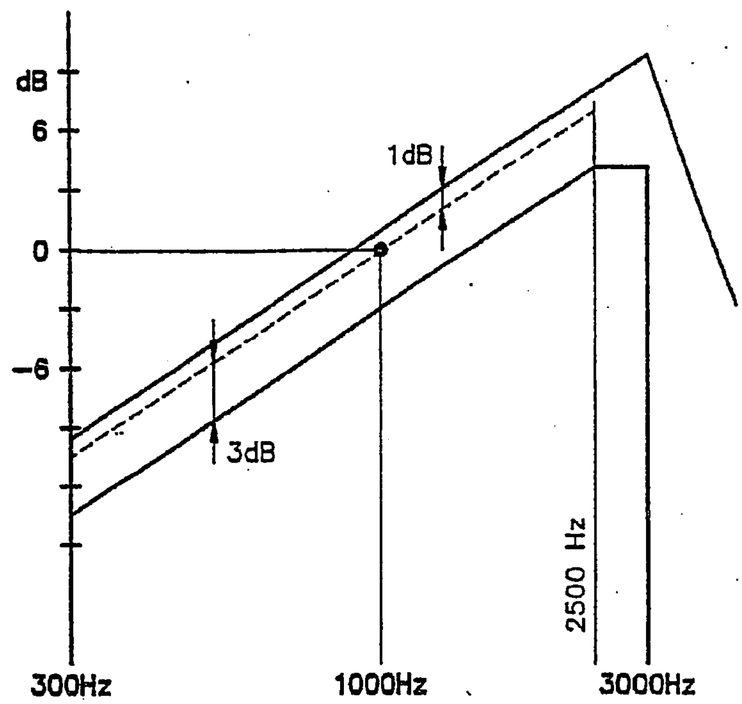

Figure 5. Frequency deviation relative to 1 kHz at constant input level.

3.2.5 Adjacent channel power

The adjacent channel power should not exceed the value specified in the national technical requirements, in case such a value is specified in the national technical requirements.

3.2.6 Harmonic distortion

The harmonic distortion factor should not exceed 5%.

3.2.7 Residual modulation

The residual modulation should not exceed - 40 dB, measured with a psophometric filter.

The residual modulation should not exceed - 20 dB, measured without filter.

3.2.8 Modulation due to vibration

The modulation due to vibration should not exceed -30 dB measured by a r.m.s. voltmeter and with a psophometric filter.

Without the psophometric filter and measured by a peak-to-peak voltmeter the modulation should not exceed -14 dB.

3.2.9 Audio muting

An input muting device controlled by the control unit should be provided. The muting to be capable of causing at least 40 dB attenuation in the voice path. Data transmission is not to start until the muting has reached an attenuation of 40 dB.

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3.3 RECEIVER

For definitions and measurement methods, please refer to Appendix A.

3.3.1 Channel switching time

The channel switching time should not exceed 30 ms including data signal detection time.

3.3.2 Squelch opening and closing levels and delays

There must be no squelch function in the receiver.

3.3.3 Signal strength indication

The signal strength to be indicated by the receiver to the control unit.

The indicated range to be :

RF-level 0 - 50 dBuV emf with a monotonic output

and absolute accuracy of

+-(2 + 10 % of actual value) dBuV emf.

The time constant to be 1 ms.

3.3.4 RF sensitivity

The receiver sensitivity (speech) not to exceed 0 dBuV emf under normal test conditions and + 4 dBuV emf under extreme test conditions.

The reference signalling sensitivity (data) not to exceed 0 dBuV emf under normal test conditions and 3 dBuV emf under extreme test conditions.

The multipath signalling sensitivity (data) must not exceed 12 dBuV emf. This measurement is only done under normal test conditions.

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3.3.5 Adjacent channel selectivity

The receiver shall comply with applicable national technical requirements.

3.3.6 Spurious response rejection

The receiver shall comply with applicable national technical requirements.

3.3.7 Co-channel rejection

The measurement is made with the wanted signal at an input level of +10 dBuV emf.

The co-channel rejection level at any frequency displacement of the unwanted signal within the specified range to be greater than -2 dBuV emf.

3.3.8 Intermodulation response

The receiver shall comply with applicable national technical requirements.

3.3.9 Blocking

The receiver shall comply with applicable national technical requirements.

3.3.10 Amplitude characteristic of the receiver

For the specified change of radio frequency input level, the change of the audio output level should not exceed 3 dB between the maximum and minimum output levels.

3.3.11 AM-suppression

The AM-suppression should not be less than 30 dB.

3.3.12 Audio frequency response

The audio frequency response, measured at the audio output terminal, should be within the limits as shown in the figure below.

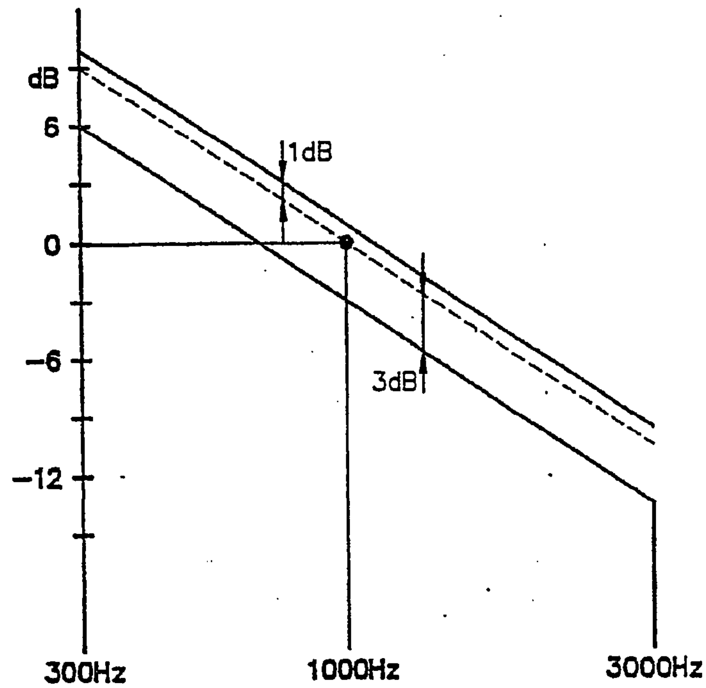

Figure 6. Audio power relative to 1kHz at constant frequency deviation.

3.3.13 Harmonic distortion

At all audio frequencies used in the measurement and under all test conditions the harmonic distortion factor should not exceed 5%.

3.3.14 Noise and hum

The receiver "noise and hum" ratio should not exceed -40 dB measured by a r.m.s. voltmeter and with a psophometric filter.

Without the psophometric filter and measured by a peak-to-peak voltmeter the "noise and hum" ratio should not exceed -20 dB.

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3.3.15 Audio output due to vibration

The noise and hum ratio of the receiver due to vibration should not exceed -30 dB measured by a r.m.s.voltmeter through a psophometric filter.

Without the filter and measured by a peak-to-peak voltmeter the the ratio should not exceed -14 dB.

3.3.16 Audio muting

An output muting device controlled by the control unit to be provided. The muting device to be capable of causing at least 40 dB attenuation in the voice path.

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4 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 6, 7, 8, 13
R1-19, 12

Below are the reference designations listed.

Reference	Section
R1-01	Arrangement of the documents
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R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

Prepared	Subject responsible	No		
ET/UC SIS	ET/UC SIS	A/1056 - A 296 5173/01 Ue		
Approved: ET/SYSC STT STT		Date: 1990-02-23	Rev: C	File: MTS18A.1

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MOBITEX MOBILE RADIO EQUIPMENT
12.5 kHz, 900 MHz
Appendix A, Measurement methods

1 INTRODUCTION

This document is an Appendix to MOBITEX TERMINAL SPECIFICATION - RADIO EQUIPMENT. It consists of requirement definitions and measurement method descriptions.

The measurement values applies to 12,5 kHz channel spacing in the 900 MHz frequency band.

The document describes measurement methods for several data transmission speeds. Therefore, measurements without specified requirement procedures in the main document can be found. These should be ignored.

The equipment specified in this document should also meet with basic requirements set up in national regulations for radio transmitters and radio receivers.

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2 MEASUREMENT METHODS

2.1 SYSTEM MEASUREMENTS

2.1.1 Receive to transmit switching time

Definition:

The switching time from receive to transmit condition is defined as the elapsed time from the end of an incoming frame with the response flag set, to the beginning of the response, i.e. the data signalling starts (see main document "Start of data modulation").

2.1.2 Transmit to receive switching time

Definition:

The switching time from transmit to receive condition is defined as the elapsed time from end of the last frame in a message sent by the transmitter, until the receiver is capable of detecting incoming data signals.

2.1.3 Channel switching time

Definition:

The channel switching time is defined as the elapsed time from the end of a received order to change channel, until the receiver is capable of detecting data signals on the new channel.

2.1.4 Frequency error

Definition:

The frequency error of the transmitter is the difference between the measured carrier frequency and its nominal value.

Method of measurement:

The carrier frequency should be measured in the absence of modulation with the transmitter connected to an artificial antenna.

The test should be made under normal and extreme test conditions.

2.2 TRANSMITTER MEASUREMENTS

2.2.1 Carrier power

Definition:

The transmitter carrier power is the mean power delivered to the artificial antenna during a radio frequency cycle in the absence of modulation.

Method of measurement:

The transmitter should be connected to an artificial antenna and the power delivered to this artificial antenna should be measured.

The measurements should be made under normal and extreme test conditions.

2.2.2 Maximum permissible frequency deviation

Definition:

The frequency deviation is the maximum difference between the instantaneous frequency of the modulated radio frequency signal and the carrier frequency in the absence of modulation.

Method of measurement:

The frequency deviation should be measured at the output of the transmitter connected to an artificial antenna, by means of a deviation meter capable of measuring the maximum deviation, including that due to any harmonics and intermodulation products which may be generated in the transmitter.

2.2.3 Audio frequency response

Definition:

The audio frequency response is the frequency deviation of the transmitter carrier as a function of modulation frequency at a constant level of the modulation signal.

Method of measurement:

A modulation signal at a frequency of 1000 Hz and adjusted to such level that a frequency deviation of (+)(-)0,5 kHz is obtained, is applied to the transmitter. The frequency

of the modulation signal is then varied between 300 Hz and 25 kHz, its level being kept constant. The connection values of frequency deviation and modulation frequency should be determined.

2.2.4 Adjacent channel power

Definition:

The adjacent channel power is that part of the total power output of a transmitter under defined conditions of modulation, which falls within a specified passband centred on the nominal frequency of either of the adjacent channels. This power is the sum of the mean power produced by the modulation, hum and noise of the transmitter.

Method of measurement:

The adjacent channel power should be measured with a power measuring receiver which fulfills the requirements given in the CEPT recommendation T/R 24-1. The transmitter should be operated at the nominal carrier power under normal test conditions. The output of the transmitter should be linked to the input of the receiver by connecting device such that the impedance presented to the transmitter is 50 ohms and the level at the "receiver" input is appropriate.

The transmitter should be modulated with a signal of 1250 Hz.

The signal of 1250 Hz should be adjusted to a level 20 dB higher than that required to produce (+)(-)1,5 kHz deviation. The "receiver" should be tuned to the nominal frequency of the transmitter and the variable attenuator in the "receiver" should be adjusted to a value p dB such that a meter reading of the order of 5 dB above the "receiver" noise level is obtained.

The "receiver" should then be tuned to the nominal frequency of one of the adjacent channels and the variable attenuator should be adjusted to a value q dB such that the same meter reading is obtained.

The measurement should be repeated with normal data test modulation (paragraph Test modulation, in the Main document).

The ratio of adjacent channel power to carrier power is the difference between the attenuator settings p and q. The adjacent channel power is determined by applying this ratio to the carrier power.

The measurement should be repeated for the other adjacent channel.

2.2.5 Harmonic distortion

Definition:

The harmonic distortion factor of a transmitter modulated by an audio frequency signal is defined as the ratio, expressed as a percentage, of the r.m.s. voltage of all the harmonic components of the fundamental audio frequency to the total r.m.s. voltage of the signal after linear demodulation.

With the method described below, when a distortion meter is used, the hum and noise components are included in the distortion measurement.

Method of measurement:

The radio frequency signal produced by the transmitter is applied, by means of a suitable coupler, to a linear demodulator equipped with a de-emphasis network of 6 dB per octave.

The radio frequency signal to be modulated successively at frequencies of 300, 500 and 1000 Hz frequency to (+)(-)1.5 kHz deviation.

The harmonic distortion factor of the audio frequency signal is measured at all the frequencies given above.

2.2.6 Residual modulation

Definition:

The residual modulation of the transmitter is the ratio, expressed in dB, of the audio frequency noise level produced after radio frequency signal demodulation, in the absence of modulation, by the wanted signal, by the spurious effects of the power supply system, by the modulator or by other causes, to the audio frequency level produced by normal test modulation applied to the transmitter.

Method of measurement:

a) The normal test modulation is applied to the transmitter. The RF signal produced by the transmitter is applied by means of a suitable coupler to a linear demodulator.

The demodulator is equipped with a de-emphasis network of 6 dB per octave.

All precautions should be taken to prevent the measurement results from being affected by emphasis at the low audio frequencies of the internal linear demodulator noise.

Measurements to be carried out on the demodulator output signal by means of an r.m.s. voltmeter equipped with psophometric filter network described in CCITT Recommendation P.53.A.

The modulation is then removed and the level of the residual audio frequency output signal is again measured.

b) The same method as a) above but without the psophometric filter at the output.

In this case the measurements are carried out by means of a peak-to-peak voltmeter.

2.2.7 <u>Modulation due to vibration</u>

Definition:

Modulation due to vibration denotes the ability of the transmitter to withstand influence on the radio frequency output signal by mechanical vibrations.

Method of measurement:

The residual modulation is measured in accordance with 5.2.2. The transmitter should during the test be vibrated in each of three directions:

10 - 100 Hz	1 m/s^2
sweep rate	1 octave per minute

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2.3 RECEIVER MEASUREMENTS

2.3.1 RF sensitivity

Definition:

The maximum usable sensitivity of the receiver is the minimum level of signal (emf) and field-strength respectively at the receiver input, at the nominal frequency of the receiver, with normal test modulation which will produce:

an audio-frequency output power of at least 50% of the rated power output and

a SND/ND ratio (S=signal, N=noise, D=distortion) of 20 dB, measured at the receiver output through a telephone psophometric weighting network as described in CCITT Recommendation P.53-A.

Note: The characteristics of the 1 kHz band-stop filter used in SND/ND measurements should be such that at the output the attenuation at 1 kHz will be at least 40 dB and at 2 kHz will not exceed 0.6 dB. The filter characteristics should be flat within 0.6 dB over the ranges of 20 Hz to 500 Hz and 2 kHz to 4 kHz. In the absence of modulation of the total noise power at the audio-frequency output of the receiver under test.

The reference signalling sensitivity data is the level and field-strength respectively of a radio frequency input signal at the nominal receiver frequency and modulated with the normal coded test signal or pseudo-random bit sequence which will produce a successful calling ratio of 80% for signalling systems with a specific response as output and a bit error ratio of 0.01 for data transmission systems with a bit stream as output respectively.

Measurement methods:

A signal of carrier frequency equal to the nominal frequency of the receiver and with normal test modulation shall be applied to the receiver input terminals. An audio frequency output load and a distorsion factor meter incorporating a 1 kHz band-stop filter and a psophometric telephone weigthing network shall be connected to the receiver output terminals. Where possible, the receiver volume control shall be adjusted to give at least 50% of the rated output power. The test signal input level shall be reduced until a SND/ND ratio of 20 dB is obtained. The test signal input level under these conditions is the maximum usable sensitivity. The measurement shall be made under normal test conditions and extreme test conditions. Under extreme test conditions, a variation of the receiver

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output power of (+)(-) 3 dB from the value obtained under normal test conditions may be allowed.

A signal of carrier frequency equal to the nominal frequency of the receiver and modulated with the normal coded test signal or a psuedo-random bit sequence shall be applied to the receiver input terminals. The level of this signal shall be such that a successful calling ratio of SCR = 80%, and a bit error ratio of BER = 0.01 respectively is obtained. The reference signalling sensitivity (data) is the maximum level of the levels recorded for SCR = 80% and BER = 0.01.

The multipath signalling sensitivity is the rms value of the level of a Rayleigh fading input signal at the nominal receiver frequency and modulated with the normal coded test signal or pseudo-random bit sequence which will produce a sucessful calling ratio of 80% and a bit error rate of 0.01. The measurements shall be carried out with a Rayleigh fading simulator set for a simulated vehicle speed of 90 km/h and repeated for a simulated vehicle speed of 50 km/h and 10 km/h. The reference multipath signalling sensitivity (data) is the maximum neccessary level of the multipath measurements.

2.3.2 Adjacent channel selectivity

Definition:

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

Method of measurement:

Two signals should be applied to the receiver via a combining network. The wanted signal should be at the nominal frequency of the receiver and be modulated with normal test modulation. The unwanted signal should be at the nominal frequency of the upper adjacent channel and be modulated with a 400 Hz tone to a frequency deviation of (+)(-)1,5 kHz.

Initially the unwanted signal should be switched off and the level of the wanted signal should be adjusted to 6 dBuV emf. The unwanted signal should then be switched on and its level adjusted until the SND/ND ratio, measured at the receiver line output terminal through the psophometric filter, is reduced to 14 dB.

The measurement should be repeated with the unwanted signal at the nominal frequency of the lower adjacent channel.

The adjacent channel selectivity should be expressed as the lower value of the receiver input levels in dBuV emf of the unwanted signal for the upper and lower adjacent channels.

2.3.3 Spurious response rejection

Definition:

The spurious response rejection is a measure of the capability of the receiver to discriminate between the wanted modulated signal of the nominal frequency and an unwanted signal at any other frequency at which a response is obtained.

Method of measurement:

Two input signals should be applied to the receiver via a combining network. The wanted signal should be at the nominal frequency of the receiver and be modulated with normal test modulation. Initially the unwanted signal should be switched off and the wanted input signal adjusted to 6 dBuV emf. The unwanted signal should be switched on and modulated with a 400 Hz tone to a frequency deviation of (+)(-)1,5 kHz. The input level of the unwanted signal should be 86 dBuV emf and its frequency should be varied at least from 100 kHz to 2000 MHz.

At any frequency at which a response is obtained, the input level of the unwanted signal should be adjusted until the SND/ND ratio, measured at the line output terminal of the receiver through the psophometric filter, is 14 dB.

The spurious response rejection should be expressed as the level in dB of the unwanted signal relative to 1 uV emf at the receiver input when the SND/ND ratio of 14 dB, as mentioned above, is obtained.

2.3.4 Co-channel rejection

Definition:

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at the nominal frequency of athe receiver.

Method of measurement:

Two input signals should be applied to the receiver via a combining network. The wanted signal should have normal test modulation. The unwanted signal should be modulated with a frequency of 400 Hz to a frequency deviation of (+)(-)1,5 kHz. Both input signals should be at the nominal frequency of the receiver and the measurement should be repeated for displacements of the unwanted signal up to (+)(-)1,5 kHz offset frequency of the nominal frequency.

Initially the unwanted signal should be switched off and the level of the wanted signal should be adjusted to +6 dBuV emf.The unwanted signal should then be switched on.

The level of the unwanted signal should be adjusted until the SND/ND ratio, measured at the line output terminal of the receiver through the psophometric filter, is reduced to 14 dB.

The co-channel rejection should be expressed as the ratio in dB of the level of the unwanted signal to the level of the wanted signal at the receiver input for which SND/ND = 14 dB at the receiver line output terminal occurs.

2.3.5 Intermodulation response

Definition:

The intermodulation response is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

Method of measurement:

Three signal generators, A, B and C, should be connected to the receiver via a combining network.

The wanted signal, represented by signal generator A, should be at the nominal frequency of the receiver and should have normal test modulation.

The unwanted signal from signal generator B should be unmodulated and adjusted to the frequency separated by 25 kHz above the nominal frequency of the receiver.

The second unwanted signal from signal generator C should be modulated with a frequency of 400 Hz with a deviation of 1,5 kHz and adjusted to the frequency 50 kHz above the nominal frequency of the receiver.

The amplitude of the wanted input signal should be adjusted to 6 dBuV emf. The amplitude of the two unwanted signals should be maintained equal and should be adjusted until the SND/ND ratio at the receiver output, psophometrically weighted, is reduced to 14 dB.

The frequency of signal generator B should be adjusted slightly, if necessary, to produce the maximum degradation of the SND/ND ratio. The level of the two unwanted test signals should be readjusted to restore the SND/ND ratio of 14 dB.

The measurement should be repeated with the unwanted signal B at 25 kHz below that of the wanted signal and the frequency of the unwanted signal C at 50 kHz below that of the wanted signal.

The intermodulation response level is the receiver input level in dB produced by each of the two unwanted signal generators relative to 1 uV emf.

2.3.6 Blocking

Definition:

Blocking is a change (generally a reduction) in the wanted output power of a receiver or a reduction of the SND/ND ratio due to an unwanted signal on another frequency.

Method of measurement:

Two input signals should be applied to the receiver via a combining network. The wanted signal should be at the nominal frequency of the receiver and should have normal test modulation. Initially the unwanted signal should be switched off and the input level of the wanted signal should be adjusted to 6 dBuV emf.

The output power of the wanted signal at the line output terminal of the receiver should be adjusted to the nominal output level. Then the unwanted signal should be switched on. The unwanted signal should be unmodulated, and its frequency should be varied between +1 MHz and +10 MHz, and also between -1 MHz and -10 MHz, relative to the nominal frequency of the receiver. The input level of the unwanted signal, at all frequencies in the specified ranges, should be so adjusted that the unwanted signal causes:

a) a reduction of 3 dB in the audio frequency output power of the wanted signal,

or

b) a reduction of the SND/ND ratio to 14 dB, measured through a psophometric filter,

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whichever occurs first.

This input level is the blocking level at the frequency concerned.

2.3.7 Amplitude characteristics

Definition:

The amplitude characteristics of the receiver is the relationship between the radio frequency input level of specified modulated signal and the audio-frequency level at the receiver output.

Method of measurement:

A test signal at a level of 6 dBuV emf at the nominal frequency of the receiver and having normal test modulation should be applied to the receiver input. The audio frequency power at the line output should be adjusted to the nominal level. The input signal should be increased to 100 dBuV emf, and the audio frequency output level should again be measured.

2.3.8 AM-suppression

Definition:

AM-suppression is the capability of the receiver to suppress amplitude modulated signals. It is expressed as the ratio in dB of the audio power at the line output terminal with normal test modulation to the audio power with a specified amplitude modulation.

Method of measurement:

A test signal at a level of 20 dBuV emf and 60 dBuV emf at the nominal frequency of the receiver to be applied to the receiver input successively. The signal should initially have normal test modulation and the voice output terminal power should be set to the nominal output level. The normal test modulation should then be replaced by amplitude modulation to 30% with a 1000 Hz tone. The audio power should again be measured. It may be necessary to make this measurement with a selective voltmeter.

2.3.9 Audio frequency response

Definition:

The audio frequency response of the receiver expresses the variation in the audio power at the line output terminal as a function of the modulation frequency of the input signal.

Method of measurement:

A test signal at a level of 60 dBuV emf at the nominal frequency of the receiver and having normal test modulation to be applied to the receiver input.

The audio power to be adjusted to 50 % of the rated output power. This setting is not to be altered during the test.

The frequency deviation at 1000 Hz then should be reduced to (+)(-)0,5 kHz and maintained constant while the modulation frequency is varied at least between 300 Hz and 5000 Hz.

The measurement is repeated with the test signal successively at plus and minus 1,25 kHz from the nominal frequency of the receiver.

2.3.10 Harmonic distortion

Definition:

The harmonic distortion factor at the voice output terminal of the receiver is defined as the ratio, expressed as a percentage, of the r.m.s. voltage of all the harmonic components of the fundamental audio frequency to the total r.m.s output voltage.

With the method of measurement described below in case a distortion meter is used, the hum and noise components are included in the distortion measurement.

Method of measurement:

Test signals of 60 dBuV emf and 100 dBuV emf at the nominal frequency of the receiver should be applied successively to the receiver input.

In each measurement the audio power at the voice output terminal should be adjusted to the nominal output level.

The test signal to be modulated successively with 300, 500 and 1000 Hz tones to (+)(-) 1,5 kHz frequency deviation and the harmonic distortion is measured at each frequency.

Under extreme test conditions, tests to be carried out at the nominal frequency of the receiver as well as at plus

and minus 1,25 kHz from the nominal frequency. In this case the input signal is modulated only with a 1000 Hz tone to a frequency deviation of (+)(-) 1,5 kHz.

2.3.11 Noise and hum

Definition:

The "noise and hum" of the receiver is the ratio, expressed in decibels, of the audio frequency noise and hum level resulting from the spurious effects of the power supply system or from other causes to the audio frequency level produced by RF-signals as specified below and applied to the receiver input.

Method of measurement:

a) A test signal at a level of 30 dBuV emf at the nominal frequency of the receiver and having normal test modulation should be applied to the receiver input. A psophometric filter to be connected at the voice output terminal. The audio power to be adjusted to nominal level.

   The output voltage is measured with an r.m.s. voltmeter.

   The modulation is then removed and the audio power measurement is repeated.

b) The same method as in case a) above, but without the psophometric filter and using a peak-to-peak voltmeter for the measurement.

2.3.12 Audio output due to vibration

Definition:

Audio output due to vibration denotes the ability of the receiver to withstand influence on a received radio frequency signal by mechanical vibrations.

Method of measurement:

The noise and hum of the receiver is measured in accordance with 5.3.6. The receiver should during the test be vibrated in each of 3 directions.

10 - 100 Hz 1 m/s^2

sweep rate 1 octave per minute

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During the vibration the radio frequency test signal should be unmodulated and the level of the receiver output signal should be measured.

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2.4 MEASUREMENT ACCURACY

The measurement instrumentation should have at least the accuracy given below:

D.C voltage	(+)(-)1%
A.C mains voltage	(+)(-)3%
A.C mains frequency	(+)(-)0,5%
Audio-frequency voltage, power, etc.	(+)(-)0,5 dB
Audio-frequency	(+)(-)0,1%
Distortion and noise, etc of audio frequency generators	(+)(-)0,5%
Radio frequency	(+)(-)20 Hz
Radio frequency voltage	(+)(-)2 dB
Radio-frequency field strength	(+)(-)3 dB
Radio-frequency carrier power	(+)(-)5%
Impedance of artificial loads, combining units, cable, plugs, attenuators, etc.	(+)(-)5%
Source impedance of generators and input impedance of measuring receivers	(+)(-)10%
Attenuation by attenuators	(+)(-)0,5 dB
Temperature	(+)(-)1 ^{o}C
Humidity	(+)(-)5%
Time	(+)(-)10%

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Dokansv. Godkänd - Doc respons. approved: ET/SYSC STT SIT		Datum - Date: 1990-02-23; Rev: A	Fil File: MTS19.3
Benämning: **Cantel Mobitex**		Title: MOBITEX Other interfaces, mobile terminal and fixed terminal	

ABSTRACT

This document specifies the interfaces between the MOBITEX network and a mobile or fixed terminal connected to the network.

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1 INTRODUCTION

1.1 GENERAL

The purpose of this specification is to give well defined interfaces for the connection of application equipment. This specification will serve as a recommendation for the mobile terminal market.

NOTE: The Radio/MCU must be type-tested with a terminal of "masc" type. A minimum number of commands (defined by document Mobitex ASyncronous Communication, APPENDIX A, Commands) are then required.

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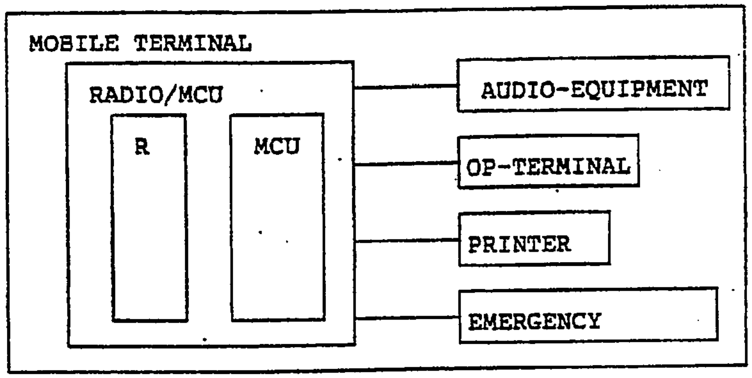
2 GENERAL DESCRIPTION

The picture below shows the mobile terminal system parts.



MOBILE TERMINAL	:	complete equipment
MCU	:	mobile control unit
AUDIO-EQUIPMENT	:	equipment like mic/speaker, handset
OP-TERMINAL	:	terminal for operators
EMERGENCY EQU.	:	equipment like emergency receiver, emergency button

2.1 Terminal interface

Asynchronous, serial data transmission. Permitted transmission rates are 600, 1200, 2400, 4800 and 9600 Baud. However, for "masc" type terminals 600 baud is not permitted. Default value is 1200 Baud. In MCU it must be possible to set any of these baud rates by hardware switches or alike. It must be possible to set the baud rate of each output separately. Normally 1 start bit, 8 data bits, 1 stop bit and no parity is used. However, masc type terminals should use 7 data bits and even parity.

2.1.1 Printer/data collection unit

Interface designed to connect a printer or any other character (text) oriented terminal. It can also be used for data collection units. This interface must be combined with one or more of the other terminal interfaces. The 7 most significant bits are coded according to MOBITEX TEXT CODE, see reference R1-06. The eighth bit is set to logical zero.

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2.1.2 Terminal with small display

Designed for connection to a unit with a limited text display area and from which the operator can enter numbers, status messages and text including simple text editing. The editor is placed in MCU. Also the audio equipment and the manual mode of the radio equipment can be handled from this unit. Character oriented format (as above) is used.

2.1.3 ANSI terminal

For connection of asynchronous full screen terminal which complies with terminal interface ANSI X 3.41 1964 and ANSI X 3.64 1979 with respect to cursor control and editing functions.
From the terminal the operator can enter numbers, status messages and text including text editing. The editor is placed in MCU. Character oriented format as above.

2.1.4 "MASC" type terminal

Connection of units with the capacity to handle complete data packets (MPAK), e.g. a personal computer. The format is block oriented which means that information is transmitted in the form of packets (MPAK) according to the format which is given in the network layer specification. Control of the complete mobile terminal, e.g. audio equipment and manual mode, is performed by special commands included in the protocol. The interface also contains functions for reading status parameters in the mobile terminal (meant for the type test). 7 bits per character and even parity to be used. Permitted transmission rates are 1200, 2400, 4800 or 9600 Baud.

For type testing, a masc type interface is required. In this case it may be implemented by external adaptors.

2.2 Audio interface

Connection of microphone and loudspeaker or handset. The interface also contains certain control functions. The handset can be combined with numeric and status keys. The same character codes as for the terminal with small display are used. The audio interface can also be combined with the terminal interface. Refer also to the application examples.

2.3 Emergency interface

Connection facilities for four units. Three connections are for emergency buttons and one is for a receiver for receiving emergency transmissions generated by a portable transmitter. Any of these units can initiate the emergency procedure in MCU.

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3 TERMINAL INTERFACE

This chapter describes the interface to equipment which communicates with MCU in serial form.

3.1 PHYSICAL INTERFACE

The physical interface is the same for all terminal types.

The terminal interface uses a 25-pole DSUB socket (female socket with pins) with the following configuration:

PIN	V.24/V.28	V.10 category 1/V.11	SOURCE
1	supply ground	supply ground	
2	transmitted data	transmitted data A	DTE
3	received data	received data A	MCU
4	*	*	
5	*	*	
6	data set ready	data set ready A	MCU
7	signal ground	signal ground	
8	*	data terminal ready B	DTE
9	system start (ground	system start (ground)	DTE
10	system start (+12V)	system start (+5V)	DTE
11	*	*	
12	*	*	
13	*	*	
14	*	transmitted data B	DTE
15	*	received data B	MCU
16	*	*	
17	*	*	
18	*	data set ready B	MCU
19	*	*	
20	data terminal ready	data terminal ready A	DTE
21	*	*	
22	ring ind.	ring ind.	MCU
23	*	*	
24	-12V (supply)	*	MCU
25	+12V (supply)	+5V (supply)	MCU

* = reserved

Note: Pins 9, 24 and 25 differ from V.28. Pins 9, 10, 24 and 25 differ from V.24.

The following applies to V10: 0 or ON is when A > B and 1 or OFF is when B > A.

The following applies to V28: 0 or ON is when V > 3V and 1 or OFF is when V < -3V.

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Pin:

2,3 The transmission rate for serial data is 600, 1200, 2400, 4800 or 9600 baud.

6 The signal "DATA SET READY" is activated as soon as MCU is ready to transmit. The signal to be activated when it is not used.

An active signal means that the physical layer is in the data transmission mode.

9 System Start, activating MCU from equipment not according to V.28.
MCU starts up within 10 seconds when pin 9 is activated (ON condition). MCU then remains on until all system start signals are inactivated.
ON condition: voltage 0V - +1V; current less than 5 mA.
OFF condition: not connected or voltage +2V - +15V; current less than 5 mA.

10 System Start, activating MCU by signal according to V.28.
MCU starts up within 10 seconds when pin 10 is activated. MCU then remains on until all system start signals are inactivated.
ON condition: voltage > 3V (see V28).

OFF condition: not connected or voltage < -3V (see V28).

20 The signal "DATA TERMINAL READY" is activated as soon as the terminal is ready to receive. The signal is to be activated when not used.

An active signal means that the physical layer is in the datatransmission mode.

22 The signal "RING INDICATION" is used to activate the periferal unit.

24 - 12 V/100 mA supply for connected equipment.

25 + 12 V (+ 5 V)/500 mA supply for connected equipment.

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3.2 PROTOCOL FOR PRINTER/DATA COLLECTION UNITS

General

Interface designed to connect a printer or any other character (text) oriented terminal. It can also be used for data collection units. This interface must be combined with one or more of the other terminal interfaces.

Receiving text

To stop the data stream from MCU temporarily, the printer sends XOFF (DC3) to MCU and to restart the data stream it sends XON (DC1).

Sending text

Text can be sent to MCU. In MCU a complete MPAK will be created with sender and addressee before it is transmitted on the radio path.

The connected unit stops sending when it has received XOFF (DC3) from MCU and does not start again until XON (DC1) is received.

3.3 PROTOCOL FOR TERMINALS WITH SMALL DISPLAY

3.3.1 Receiving data

To stop the data stream from MCU temporarily , the terminal sends XOFF (DC3) and to restart the data stream it sends XON (DC1). Received characters in the code range 32 - 126 (decimal) are printed out directly. Other codes are interpreted by the terminal according to the following table:

CHARACTER	CODE	TERMINAL'S INTERPRETATION OF CHARACTER
000	NUL	-
001	SOH	-
002	STX	-
003	ETX	-
004	EOT	-
005	ENQ	-
006	ACK	-
007	BEL	give audible signal
008	BS	move cursor one step to left
009	HT	-
010	LF	line feed
011	VT	-
012	FF	-
013	CR	move cursor to beginning of line
014	SO	-
015	SI	-
016	DLE	-
017	DC1	resume sending data
018	DC2	-
019	DC3	stop sending data
020	DC4	-
021	NAK	-
022	SYN	-
023	ETB	-
024	CAN	-
025	EM	-
026	SUB	-
027	ESC	carry out function as defined below
028	FS	-
029	GS	-
030	RS	-
031	US	-
127	DEL	-

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SEQUENCE	FUNCTION WHEN RECEIVED		
<ESC>[Ax	place the cursor at position x		
<ESC>[Bx	insert character x at cursor position		
<ESC>[Cx	delete character at cursor and insert character x at end of line		
<ESC>[Dx	delete character at cursor and insert character x at beginning of line		
<ESC>[E	send user information		
<ESC>[H	send display size		
<ESC>[M	restart of terminal from MCU		
<ESC>[N	display visible <CR>		
<ESC>[O	display visible <LF>		
<ESC>[P	LED1:	on	(contact with system)
<ESC>[Q	(green)	blinking	(no contact with system)
<ESC>[R		off	(power off)
<ESC>[S	LED2:	on	(external call ind. on)
<ESC>[T	(orange)	blinking	(no function)
<ESC>[U		off	(external call ind. off)
<ESC>[Y	LED3:	on	(Manual radio mode)
<ESC>[Z	(yellow)	blinking	(Call indication man. mode)
<ESC>[[		off	(MOBITEX)

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3.3.2 Sending data

The terminal stops when it has received XOFF (DC3) from MCU and does not restart until XON (DC1) is received. All characters are interpreted as when receiving except for the <ESC> sequences defined in the following table:

SEQUENCE	FUNCTION WHEN SENDING
<ESC>0A	place cursor at beginning of text
<ESC>0B	place cursor at end of text
<ESC>0C	move cursor one step to the right
<ESC>0D	move cursor one step to the left
<ESC>0E	user information follows (2048 octets)
<ESC>0Hxy	display size: x=character/line, y=no. of line
<ESC>0K	user information missing
<ESC>0M	send message
<ESC>0P	LINE CONNECTION start
<ESC>0Q	STATUS
<ESC>0R	EMERGENCY
<ESC>0W	TELEX
<ESC>0X	DATEX
<ESC>0l	copy
<ESC>0m	lock
<ESC>0n	LINE CONNECTION end
<ESC>0o	external call indication on/off (toggle)
<ESC>0p	TEXT
<ESC>0q	increase audio volume
<ESC>0r	decrease audio volume
<ESC>0s	loudspeaker on/off (toggle)
<ESC>0t	cancel
<ESC>0u	TELEPHONE
<ESC>0v	MANUAL RADIO MODE

When the terminal is sending, the character DEL (decimal 127) is interpreted as the terminal wishing to remove the character to the left of the cursor.

Following ASCII codes are used to control MANUAL RADIO mode:

Q	
W X	channel number where x=channel number 01 - 99
E	squelch on/off (toggle)
R xxxxxxx	selective call to xxxxxxx, x = 0 - 9
T	transmit call tone
Y	loudspeaker on/off (toggle)
U	scanning
I	external call indication on/off (toggle)

3.4 PROTOCOL FOR ANSI TERMINAL

3.4.1 Receiving data

To stop the data stream from MCU temporarily, the ANSI terminal sends XOFF (DC3) and to restart the data stream it sends XON (DC1). Received characters in the code range 32 - 126 (decimal) are displayed directly. Other codes are interpreted by the ANSI terminal according to the following tables:

CHARACTER	CODE	ANSI terminal's interpretation of character
000	NUL	-
001	SOH	-
002	STX	-
003	ETX	-
004	EOT	-
005	ENQ	-
006	ACK	-
007	BEL	give audible signal
008	BS	move cursor one step to the left
009	HT	-
010	LF	line feed
011	VT	-
012	FF	-
013	CR	carriage return
014	SO	-
015	SI	-
016	DLE	-
017	DC1	resume sending data
018	DC2	-
019	DC3	stop sending data
020	DC4	-
021	NAK	-
022	SYN	-
023	ETB	-
024	CAN	-
025	EM	-
026	SUB	-
027	ESC	carry out function as defined below
028	FS	-
029	GS	-
030	RS	-
031	US	-

SEQUENCE	FUNCTION WHEN RECEIVING
<ESC>[A	cursor up one step
<ESC>[B	cursor down one step
<ESC>[C	cursor right one step
<ESC>[D	cursor left one step
<ESC>[c	restart of terminal from MCU
<ESC>[0q	switch off LED1--LED4 (not ANSI)
<ESC>[1q	switch on LED1 (not ANSI)
<ESC>[2q	switch on LED2 (not ANSI)
<ESC>[3q	switch on LED3 (not ANSI)
<ESC>[4q	switch on LED4 (not ANSI)

For the meaning of LED1 - LED3 see terminal with small display.

If additional functions are required, we recommend the use of functions and control sequences in accordance with ANSI X 3.41 1974 and ANSI X 3.64 1979.

3.4.2 Sending data

The ANSI terminal stops sending when it has received XOFF (DC3) from MCU and does not restart until XON (DC1) is received. All characters are interpreted as when receiving, except for the <ESC> sequences defined in the following table:

SEQUENCE	FUNCTION WHEN SENDING
<ESC>OA	move cursor up one step
<ESC>OB	move cursor down one step
<ESC>OC	move cursor one step to the right
<ESC>OD	move cursor one step to the left
<ESC>OE	
<ESC>OF	-
<ESC>OG	-
<ESC>OHxy	display size: x=character/line,y=no. of lines
<ESC>OI	-
<ESC>OJ	-
<ESC>OK	user information missing
<ESC>OL	-
<ESC>OM	send message
<ESC>ON	-
<ESC>OO	-
<ESC>OP	LINE CONNECTION start
<ESC>OQ	STATUS
<ESC>OR	EMERGENCY
<ESC>OS	-
<ESC>OT	-
<ESC>OU	-
<ESC>OV	-
<ESC>OW	TELEX (not in ANSI standard)
<ESC>OX	DATEX (not in ANSI standard)
<ESC>OY	-
<ESC>OZ	-
<ESC>O[	-
<ESC>O\	-
<ESC>O]	-

(Continued on next page)

SEQUENCE	FUNCTION WHEN SENDING
<ESC>Oa	-
<ESC>Ob	-
<ESC>Oc	-
<ESC>Od	-
<ESC>Oe	-
<ESC>Of	-
<ESC>Og	-
<ESC>Oh	-
<ESC>Oi	-
<ESC>Oj	-
<ESC>Ok	-
<ESC>Ol	copy
<ESC>Om	lock
<ESC>On	LINE CONNECTION end
<ESC>Oo	external call indication on/off (toggle)
<ESC>Op	MOBITEX, start sending message
<ESC>Oq	increase volume
<ESC>Or	decrease volume
<ESC>Os	loudspeaker on/off
<ESC>Ot	cancel
<ESC>Ou	TELEPHONE
<ESC>Ov	scroll up presentation field
<ESC>Ow	scroll down presentation field
<ESC>Ox	get next message
<ESC>Oy	-
<ESC>Oz	-
<ESC>O{	-
<ESC>O|	-
<ESC>O}	-

When the terminal is sending the character DEL (decimal 127) is interpreted as the terminal wishing to remove the character to the left of the cursor.

3.5 PROTOCOL FOR "MASC" TYPE TERMINALS

The masc type interface is designed for connection of units with the capacity to handle complete data packets (MPAK see reference R1-09), e.g. a personal computer. Information is transferred between the terminal and MCU in the form of frames, described in subsequent clauses. Control of the complete mobile terminal, e.g. audio equipment and manual mode, is performed by special commands included in the protocol. The interface also contains functions for reading status parameters in the mobile terminal (meant for the type test).

For type testing, a masc type interface is required. In this case it may be implemented by external adaptors. For the type testing, only the basic commands and the type testing commands are required.

A frame is formed as a message packet with unique characters marking the beginning and the end of the frame. Sending may be initiated from both sides. The information frame must be acknowledged with ACK before the next information frame is sent.

The characteristics of the protocol are:

- All characters are coded into the 7 least significant bits and bit 8 is used for even parity.
- The error control is done by longitudinal and character parity check and frame length control,
- Transparent data can be sent in hex coded data fields.
- The protocol permits full duplex.

3.5.1 Frame structure

Communication takes place in the form of frames. There are two types of frames, information frames and control frames. The information frames are used to transfer commands and other information. The control frames are used to control the information frame flow.

The Information frames are divided into the following fields (number of octets stated below):

start	length	text	std.	data	check	end
1	4	1-256	1	0-1120	2	1

The Control frames are divided into the following fields (number of octets stated below):

start	type	sequ	end
1	1	0-1	1

The maximum frame size permitted is set up by the B-command. The maximum possible size is 1150 octets. This means that an Information frame can not have the maximum length in all fields.

- Start

The start of a frame is denoted by the character ^ with code 136/94/5E in octal/decimal/hexadecimal notation.

All characters received before the start character should be ignored. Every start character is the beginning of a new frame.

- Length

The size of the frame, in number of octets, should be written in this field with the ASCII codes of four hexadecimal digits. The least significant digit should always be written in octet 4.

The size of the frame includes all octets including start and end characters.
Permitted characters of length field: 0-9, A-F.

- Text

Text is a field which determines the meaning and the interpretation of the frame. The interpretation of the text field is carried out by a higher layer. The text field consists of at least 1 character and a maximum of 256 characters. Numeric information, e.g. command parameters, are always to be given as the ASCII codes of the corresponding hexadecimal digits 0-F.
Permitted characters of text field are:
SPACE (40/32/20) to } (175/125/7D) except Std(:) and startcharacter(^).

- Std (start data)

Text and data are separated by the character : (colon 72/58/3A). Std should be stated even if the data field is empty.

- Data

The data field consists of data.
The coding of the data field is carried out in hexadecimal code so that transparent data can be sent. Each octet of data which is to be coded into the data field is divided into two half octets with four bits in each. Each of these four bit groups is then represented in the data field by the ASCII code of the corresponding hexadecimal digit 0-F. Thus each input octet is represented by two characters (octets) in the data field.

The data field consists of maximum 1120 characters.
Permitted characters of data field is: 0-9, A-F.

- Check

Longitudinal checksum created by exclusive OR on all characters starting with the start character and ending with the character before the checkfield. The check field consists of two ASCII coded hexadecimal digits with the least significant digit in octet 2.

Permitted characters for the check field is: 0-9, A-F

- Type

The type of control frame is stated with one character. The characters which may be used are * (52/42/2A), ? (77/63/3F), ! (41/33/21), # (43/35/23) or & (46/38/26).

- Sequ (sequence number)

The sequence number for ACK-frames. The sequence number can be one of the characters 0 (60/48/30), 1 (61/49/31) or - (minus, 55/45/2D).

- End

The frame is terminated with the carriage return character (CR, 15/13/0D). A frame which is not ended with the end character should be ignored.

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3.5.2 Information frame

Messages are sent as Information frames with an expected acknowledgement (ACK).

The text field of an Information frame has the following general structure:

com	SP	par
>=1	0-1	>=0

com is the command or function code.

SP is the space character (ASCII code 40/32/20 in octal/decimal/hexadecimal notation) which separates the command from the parameters.

par is the ASCII coded parameters or data.

A command which sets parameter A to 587 can be coded in the following ways (all commands are terminated with CR):

```
^0010S A=587:50
^0012SET A/587:D1
^0010S A:028BAF            028B is hex code for 587
^000FSA:028B78             SA is a command
```

Note: The textfield can only consist of one (1) command.

3.5.3 Control frames

The protocol consist of the following control frames:

- ACK
- NACK
- RACK
- SENS
- SACK

- **ACK** (Acknowledgement of a correct received frame)

Structure:

^	*	sequ	CR
1	1	1	1

ACK means that the received Information frame is correct. A correct frame should comply with the following:
- starts with the start character (^)
- contains only one colon (:)
- the fields "check" and "length" have the correct values
- only permitted characters in text and data fields
- no characters with parity error
- the permitted number of characters has not been exceeded in any individual field or in the complete frame.
- ends with the end character (CR)

The field "sequ" (sequence number) should alter between ASCII character 0 and ASCII character 1 for each frame sent, except when repeating the latest ACK on a RACK request. Then the same value as before is sent again.
The first time an ACK is sent "sequ" should be the character 0. If a RACK is received before any ACK has been sent, the field "sequ" will be filled with the character - (minus). "Sequ" with the value of - (minus) is only used when RACK is received before ACK has been sent the first time.

- **NACK** (No acknowledgement of an incorrect received frame)

Structure:

^	?	CR
1	1	1

NACK is to be sent if the conditions for sending ACK are not fulfilled and the Information frame:
- starts with the start character (^)
- contains only one colon (:)
- has a total length of 10 characters or more
- ends with the end character (CR)

Should the criteria not be fulfilled for sending ACK or NACK, no reply will be given. The frame will then be repeated by the timeout function in the sending unit.

If the receiving unit cannot handle the incoming data flow, NACK may be used to limit the flow.

- **RACK** (Request for repetition of the latest sent ACK).

Structure:

^	!	CR
1	1	1

RACK, request for repetition of the latest sent ACK, is sent when no reply on the Information frame has been received within 10 seconds. The receiver of RACK is to reply by repeating ACK with the latest sequence number (sequ) used.

- **SENS** (link layer control)

Structure:

^	#	CR
1	1	1

SENS is used to control the communication link when there is no traffic. The sender decides when SENS will be sent. Time between 2 SENS should be at least 10 seconds.

When sending a SENS a reply (SACK) will be received within 10 seconds. If no reply is received within 10 seconds, a new SENS will be sent. When two SENS have been sent and no reply is received or no info-frame has been correctly transmitted, the communication link is supposed to be broken. A restart will be done by sending a B-frame.

If SACK is received and no SENS has been sent, the SACK will be ignored.

- **SACK** (Sens acknowledgement)

Structure:

^	&	CR
1	1	1

SACK will be sent when a controlframe (SENS) has been received. It should be sent at the first possible opportunity when nothing else is being sent.

3.5.4 Flow control and error handling

If the reply of an Information frame is ACK, the Information frame will be correctly received. The field "sequ" is saved as the latest received sequ number.

If the reply is a NACK, the Information frame will be repeated.

If there is no reply within 10 seconds after the Information frame was sent, a RACK will be sent. If there is no reply on the RACK, a new RACK will be sent every 10 seconds. If no ACK has been received within 30 seconds after the Information frame was sent (time-out), higher layers will be notified. However, the repetition of RACK will continue until interrupted by higher layers or by the fact that an ACK has been received.

When an ACK is received as a reply to a RACK, the sequ number of this ACK will be compared with the stored sequ number of latest received ACK. If the numbers are equal, the Information frame was not received and must be repeated. If the numbers are different, the Information frame was received correctly (but ACK was lost) and the Information frame should not be repeated. However, if the sequ number of the received ACK is - (minus) the Information frame must be repeated.

When the physical layer gets into datatransmission mode the link layer is supposed to start up.

When one of the two interconnected units is started up, it has no stored value of the sequ of the latest received ACK. Neither does it have a value of the sequ of the latest sent ACK. To handle this situation and to prevent a possible doubling of the first frame, the following start up procedure is required:

- The first Information frame sent should be a B-frame. This B-frame consists of communication parameters for masc protocol(see appendix A).

- If the sending of that B-frame leads to error handling with RACK, the B-frame must be repeated regardless of the value of the sequ field of the ACK response to RACK.

The actions to be taken when receiving ACK as a response to RACK are summarized in the following table:

		sequ of received ACK -	0	1
sequ of the latest received ACK	none	repeat	repeat	repeat
	0	repeat	repeat	no rep.
	1	repeat	no rep.	repeat

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Communication is on a full duplex line. This means that a message stream can be in progress in both directions at the same time. Both parties may send an Information frame independently of each other and an Information frame may therefore be received when a control frame is expected (ACK/NACK). However, the next incoming frame will then be a reply as each Information frame is to be acknowledged before a new one is sent. The minimum time between these two frames will be the time set by the int (interval) parameter of the B-command (minimum time between the sending of two subsequent frames).

3.5.5 Time diagram

0. MCU/terminal starts up by setting protocol parameters.
1. MCU sends Information frame 0 to terminal which sends acknowledge.
2. MCU sends Information frame 1 which is disturbed and then repeated after NACK from terminal.
3.0 MCU sends Information frame 2 but it does not reach the terminal the first time. Information frame repeated after RACK and repeated ACK being the same as previous ACK (sequ=0).
3.1 The same as 3.0 but this time ACK(1) does not reach the sender. RACK is sent and now the repeated ACK, having a new sequ, indicates that the frame was received correctly.
4. MCU and terminal sending Information frames at the same time.
5. MCU and terminal doesn't start at the same time.
5.5 MCU restarts and B-frame is repeated.

(Number in brackets after ACK denotes sequence number)

```
       MCU          |      masc  protocol     | operator terminal
--------------------+-------------------------+------------------
0.  B(len,int)      |    --------------->     |
                    |    <---------------     |    ACK(0)
                    |    <---------------     |    B(len,int)
    ACK(0)          |    --------------->     |
                    |                         |
1.  Info frame 0    |    --------------->     |
                    |    <---------------     |    ACK(1)
                    |                         |
2.  Info frame 1    |    -------X-------->    |
                    |    <---------------     |    NACK
    Info frame 1    |    --------------->     |
                    |    <---------------     |    ACK(0)
                    |                         |
3.0 Info frame 2    |    ---------->/         |
    timeout 10 s    |                         |
    RACK            |    --------------->     |
                    |    <---------------     |    ACK(0)
    Info frame 2    |    --------------->     |
                    |    <---------------     |    ACK(1)
                    |                         |
3.1 Info frame 2    |    --------------->     |
                    |           /<------      |    ACK(1)
    timeout 10 s    |                         |
    RACK            |    --------------->     |
                    |    <---------------     |    ACK(1)
```

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Nr No		
1056 - A 296 5175/3 Ue		
Datum Date: 1990-02-23	Rev: A	F. File: MTS19.3

MCU	masc protocol	operator terminal
4. Info frame 3	---------------->	
	<---------------	Info frame 4
time>=int		
	<---------------	ACK(0)
ACK(1)	---------------->	
5. start of MCU		
B(len,int)	---------------->	
timeout 10 s		
RACK	---------------->	
		start of op.term
	<---------------	B(len,int)
ACK(0)	---------------->	
timeout 10 s		
RACK	---------------->	
	<---------------	ACK(-)
B(len,int)	---------------->	
	<---------------	ACK(0)
5.5 start of MCU		working
B(len,int)	---------------->	
	/<--------	ACK(0)
timeout 10 s		
RACK	---------------->	
	<---------------	ACK(0)
B(len,int)	---------------->	
	<---------------	ACK(1)

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Nr No. 1056 - A 296 5175/3 Ue		
Datum - Date 1990-02-23	Rev A	Fil. File MTS19.3

4 AUDIO INTERFACE

This interface is intended for the connection of audio equipment such as microphone and loudspeaker or a handset. The interface also contains certain control functions.

A simple audio equipment can consist of a loudspeaker and a microphone or a handset with holder and switches to activate the functions needed (hook on/off, push-to-talk). The handset can also be a more complex unit using serial data to communicate over the interface and including a small display and numeric and status keys. Some examples are given in application examples.

4.1 PHYSICAL INTERFACE

The terminal interface uses a 15-pole DSUB socket (female socket with pins) with the following configuration:

PIN	SIGNAL	ACTIVE	SOURCE
1	ground for earphone/loudsp		MCU
2	data send		audio equipment
3	data receive		MCU
4	extern. call indic. on/off	on = 0V	audio equipment
5	volume up	up = 0V	audio equipment
6	volume down	down=0V	audio equipment
7	ground for control signals		MCU
8	system start	start=0V	audio equipment
9	+12V		MCU
10	-12V		MCU
11	microphone LF		audio equipment
12	microphone ground		
13	microphone hook on/off	lifted=0V	audio equipment
14	transmit/receive switch	transm.=0V	audio equipment
15	earphone/loudspeaker LF		MCU

pins:

2,3 Data send/receive
V24/V28 applies.
Data is formatted in accordance with "terminal with small display".

4 External call indication on/off
When pin 4 is activated, MCU toggles the external call indication on/off. When on, the external call indicator (e.g. horn) is activated when a message is received.

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pins:

5,6 Volume up/down

Grounding pin 5 or 6 will adjust the audio level (volume) of the loudspeaker or the earphone, whichever is active when the pin is activated. (The audio level of the inactive unit will remain as before.) The adjustment is made in steps, one step for each new activation of the pin. If the pin is activated continuously, the level to be adjusted by one step per second. The lowest level possible to set must still be noticeable.

8 System start

MCU will start up within 10 seconds when pin 8 is activated. It then remains on until switched off by other means even if the pin is inactivated.

9,10 Power supply of connected equipment

+12V (pin 9) is able of supply a current of at least 500 mA and -12V (pin 10) a current of at least 100 mA.

11,12 Microphone input

Input impedance: 10 kohm.
Sensitivity: An input signal with the frequency 1 kHz and a level of 100 mV produces an RF deviation of 3.0 kHz. This level is produced by the microphone at a sound pressure of 94 dB above $2*10^{-5}$ pascal.

13 Microphone hook on/off

When the microphone or handset is lifted from its holder, pin 13 is activated (HOOK_OFF signal generated). If a handset with earphone is used, the loudspeaker will be inactivated and the earphone activated. When the microphone or handset is placed in its holder again, pin 13 will be inactiveted (HOOK_ON signal generated). If an earphone has been used, it will be inactivated and the loudspeaker activated (for audio level settings, see pin 5,6).

14 Transmit/receive switch

When activated, the radio unit will transmit and when deactivated, the radio unit will receive (push-to-talk switch).

1,15 Earphone/loudspeaker

This output is able to support impedances down to 4 ohms.
Earphone sensitivity: The earphone produces a sound pressure of 85-95 dB above $2*10^{-5}$ pascal when driven by a signal with the frequency 1 kHz and a level corresponding to an RF deviation of 3.0 kHz.

5 EMERGENCY INTERFACE

5.1 PHYSICAL INTERFACE

The terminal interface uses a 15-pole DSUB socket (female socket with pins) with the following configuration:

PIN	SIGNAL	ACTIVE	SOURCE
1	emergency 1	emerg=0V	emergency equip.
2	emergency ACK	ACK =0V.	MCU
3	emergency_ack. from fixed	emack=0V	MCU
4	emergency_ack. ACK	ACK =0V	emergency equip.
5	*		
6	emergency 2	emerg=0V	emergency equip.
7	ground for control signal		
8	system start	start=0V	emergency equip.
9	+12V (supply)		MCU
10	*		
11	emergency 3	emerg=0V	emergency equip.
12	emergency 4	emerg=0V	emergency equip.
13	emergency LF input		emergency equip.
14	emergency LF ground.		emergency equip.
15	external indicator	on = 0V	MCU

* = reserved

pins:

1 . <u>Emergency 1</u>
Emergency alarm from an external emergency unit, e.g. a receiver for emergencies sent on radio from a pocket transmitter. Emergency 1 (pin 1) is used together with pin 8 (system start) and pin 2 (emergency ACK from MCU) to be able to initiate an emergency alarm even if MCU is powered off. When the external emergency unit initiates the alarm, it activates both pin 1 (emergency 1) and pin 8 (system start). After detecting the alarm, MCU sends an acknowledge to the emergency unit by activating pin 2 (emergency ACK from MCU). The emergency unit must keep pins 1 and 8 activated until this ACK has been received.
MCU will then create and send a SOS packet to the network.

2 <u>Emergency ACK from MCU</u>
Emergency ACK is an acknowledgement from MCU that emergency 1 has been received by MCU (response to activation of pin 1).

3 **Emergency acknowledgement from fixed terminal**
When the fixed terminal has received the emergency message (SOSINFO), it can send a special emergency acknowledge packet (SOSACK) or a request for an emergency connection (SOSCONREQ) addressed to the alarming subscription. When a SOSACK is received by MCU, it indicates this to the emergency unit by grounding pin 3. The emergency unit in turn grounds pin 4 as an acknowledgement.
Additional reactions from MCU when receiving SOSACK or SOSCONREQ are very much depending on application. A parameter emergency-acknowledge-status should be implemented and stating at least the following:

status =
0 no additional reaction
1 activate external indication (e.g. horn)
2 emergency line connection in direction mobile to base (one-way, mobile transmitting)
3 send acknowledge to op. terminal

4 **Emergency acknowledgement ACK from emergency unit**
Used by the emergency unit to acknowledge the activation from MCU of pin 3.

6,11,12 **Emergency 2, 3 and 4**
These pins are intended for initiating an emergency alarm from simple emergency equipment such as a single push button. When one of these pins is activated, MCU creates a SOS packet and sends it to the network. Should the pin remain active, the time between repeated SOS packets must be at least 1 minute. The signals are not acknowledged by MCU.

8 **System start**
MCU will start up within 10 seconds when pin 8 is activated. It then remains on until switched off by other means even if the pin is inactivated.

9 **Power supply for external equipment**
+12V is able to supply a current of at least 500 mA. (The emergency unit should always be powered up)

13,14 **Emergency LF input (for emergency connection)**
Input impedance: 10 kohm.
Sensitivity: An input signal with the frequency 1 kHz and a level of 100 mV produces an RF deviation of 3.0 kHz. This level is produced by the microphone at a sound pressure of 94 dB above $2*10^{-5}$ pascal.

15 **Activation of external indicator**
This pin is used to activate an external indicator (e.g. horn). It is able to sink at least 100 mA to operate e.g. a relay which activates the horn (open collector output).

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5.2 Time diagram:

EMERGENCY UNIT (emergency 1):

packet	radio path	RADIO/MCU	interface	em. unit
		start	<--- 8	start up
		emergency 1	<--- 1	emerg.1
		emergency ACK	2 --->	ack
SOS	<-------	send emergency signal		
		(external indicator		
		might be activated	15 --->	horn)

IN CASE OF MANUAL ACKNOWLEDGE FROM FIXED TERMINAL AFTER RECEIVING SOSINFO

SOSACK	-------->	emerg._ack from fixed		
			3 --->	fixd ack
			<--- 4	ack
		acc. to em.ack.status		
		(e.g. ext. indicator	15 --->	horn)

EMERGENCY BUTTON (emergency 2, 3 or 4):

packet	radio path	RADIO/MCU	interface	em.butt.
		emergency 2 (3 or 4)	<--- 6	emerg.2
SOS	<--------	send emergency signal		
		(external indicator		
		might be activated	15 --->	horn)

IN CASE OF MANUAL ACKNOWLEDGE FROM FIXED TERMINAL AFTER RECEIVING SOSINFO

SOSACK	-------->	emerg._ack from fixed		
			3 ---/	
		acc. to em.ack.status		
		(e.g. ext. indicator	15 --->	horn)

6 APPLICATION EXAMPLES

The interfaces can be used in a variety of ways depending on the application. Below are some examples given.

The terminal equipment can be connected to these interfaces.

terminal interface plug — 25pin

OP. TERMINAL

The op. terminal comprises a display for message presentation and editing and a keyboard for entering commands and information.

printer interface plug — 25pin

PRINTER

Printer for printing out text or data collection unit sending text strings.

audio interface plug — 15pin

AUDIO EQUIPMENT

Loudspeaker and microphone or handset with or without keys.
Switches/buttons to control interface signals and/or serial data according to V24/V28.

emergency interface plug — 15pin

EMERGENCY EQUIPMENT

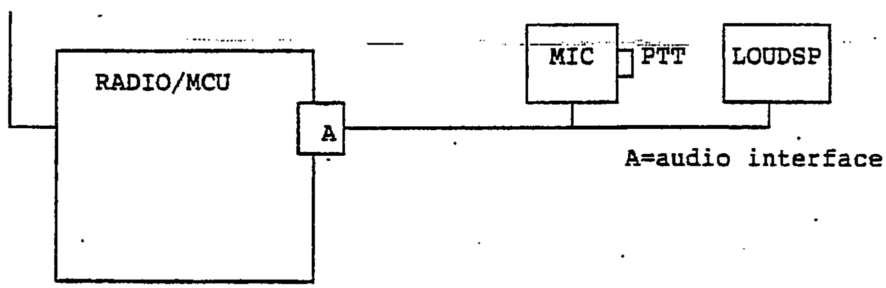
Emergency unit, e.g. receiver for emergencies from pocket transmitter, or simple emergency buttons to initiate emergency signal (SOS) from MCU.

The following examples are described:

1. Microphone/loudspeaker
2. Handset with numeric and function keys
3. Handset with numeric and function keys, printer
4. Microphone/loudspeaker, control unit, printer
5. Op. terminal with small display, loudspeaker, printer
6. Op. terminal of ANSI type, microphone/loudspeaker, data collection unit
7. PC, microphone/loudspeaker
8. PC, handset with keys, printer, emergency equipment
9. PC, microphone/loudspeaker, control unit, printer, emergency equipment

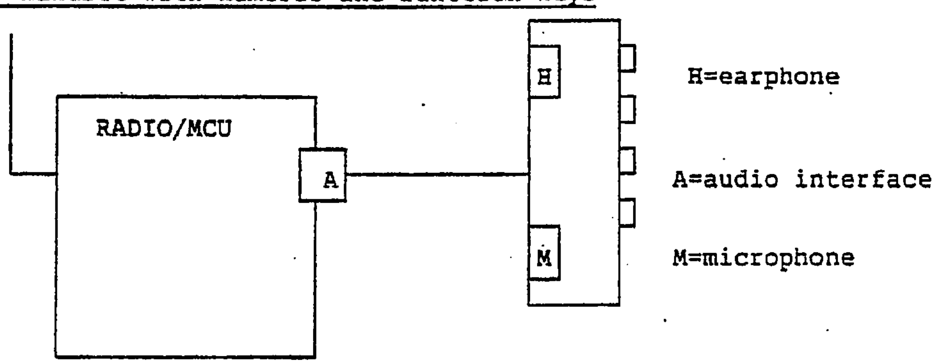
(PTT = push-to-talk button)

1. Microphone/loudspeaker



Is able to send/receive speech. (Sends only to default receiver)

2. Handset with numeric and function keys



Is able to send/receive status and speech.

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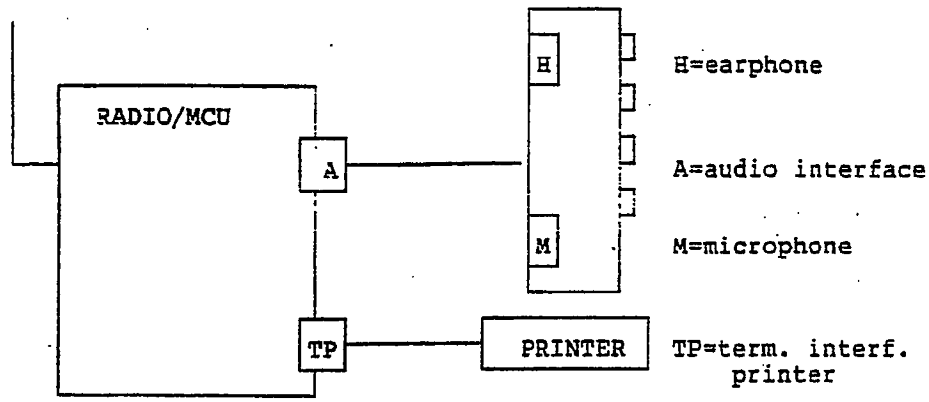
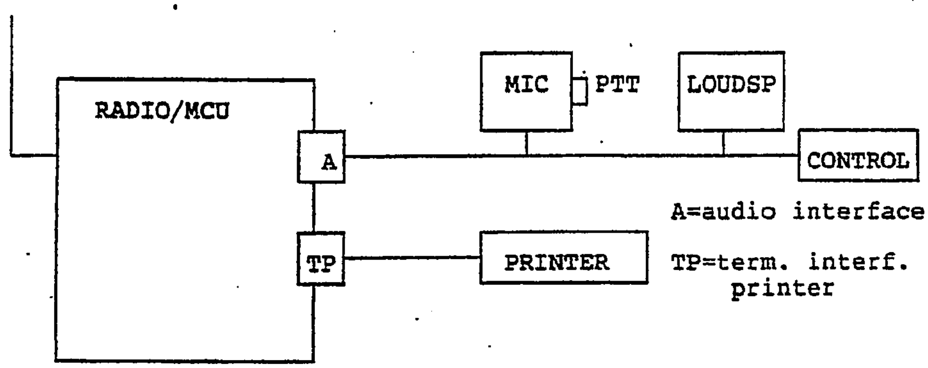
3. Handset with numeric and function keys, printer



Is able to send/receive status and speech and to receive text.

4. Microphone/loudspeaker, control unit, printer



Is able to send/receive status and speech and to receive text.

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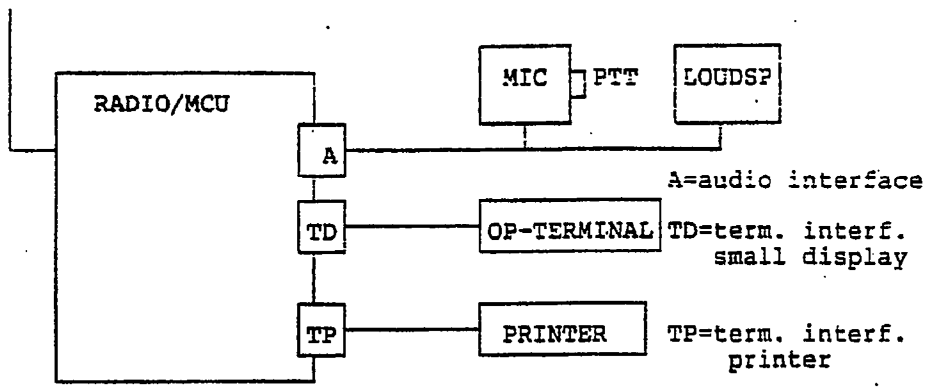
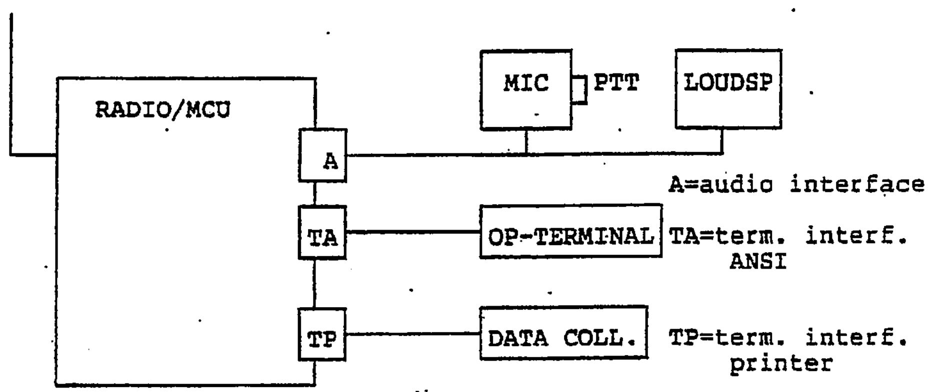
5. Op. terminal with small display, microphone/loudspeaker, printer



Is able to send/receive text, status and speech.

6. Op. terminal of ANSI type, microphone/loudspeaker, data collection unit.



Is able to send/receive text, data, status and speech. Data can be controlled and collected over radio in the form of text strings to and from the data collection unit.

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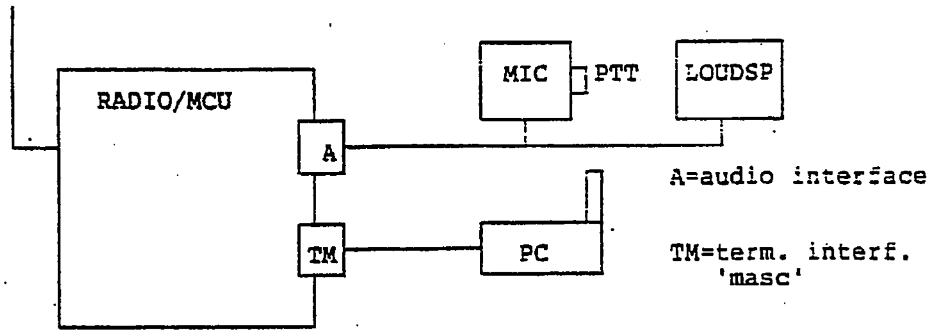
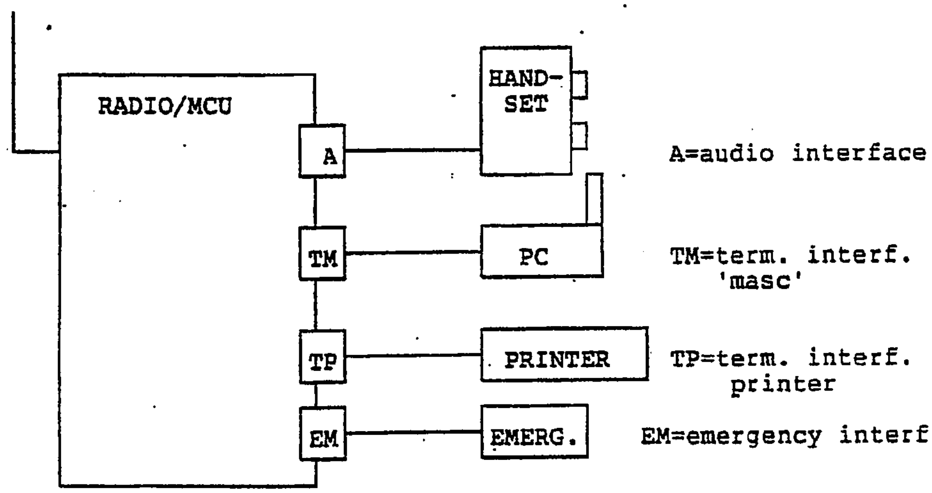
7. Personal computer as terminal, microphone/loudspeaker



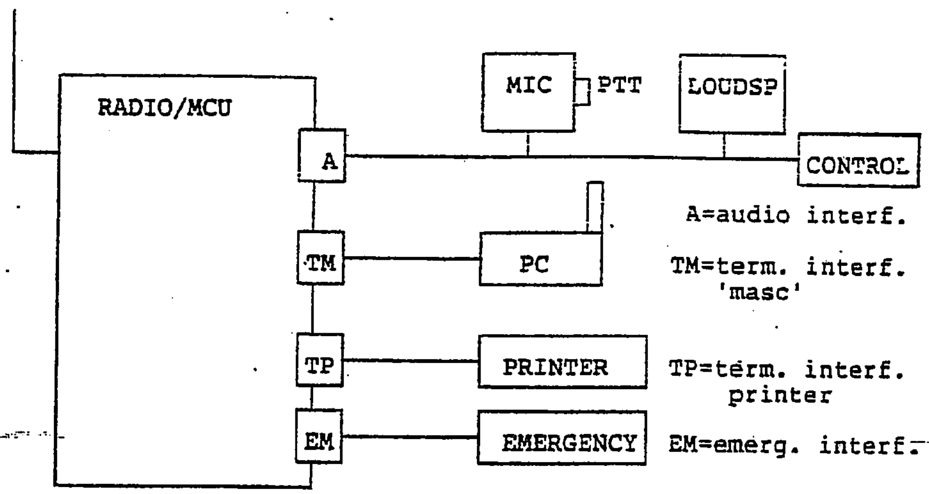
Is able to send/receive text, data, status and speech.

8. Personal computer as terminal, handset with numeric and function keys, printer, emergency equipment



Is able to send/receive text, data, status, speech and emergency.

9. Personal computer as terminal, microphone/loudspeaker, control unit, printer, emergency equipment



Is able to send/receive text, data, status, speech and emergency.

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7 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 4
R1-09, 16

Below are the reference designations listed.

Reference	Section
R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05	References
R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

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Uppgjord - Prepared: ET/SYS PES	Faktaansvarig - Subject responsible: ET/SYS PES	Nr: 2/1056 - A 296 5175/2 Ue	
Dokansv/Godkänd - Doc responsible/approved: ET/SYSC STT		Datum - Date: 1990-02-26 · Rev: A	File: MTS19A.2
Benämning: Cantel Mobitex		Title: MOBITEX Terminal Specification Mobitex ASyncronous Communication APPENDIX A, Commands	

ABSTRACT

This document specifies commands in the interface MOBITEX ASyncronous Communication(MASC) used between an application and a mobile terminal.

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1 INFORMATION FRAME COMMANDS AND FUNCTIONS IN MOBILE TERMINAL

The commands, questions and replies available as information frames in MASC are summarized below and a description is given on the following pages.

1.1 BASIC FUNCTIONS

The following commands are always to be implemented in MCU.

B	parameters for the MASC protocol
M	send/receive MPAK via radio
E	error command or function
N	return of MPAK that has not been sent
R	return of incorrect MPAK
D	route received MPAKs to an output
S	send MPAK to the specified output
T	request or transfer of emergency text
U	send emergency signal (SOS-packet)
F P	terminal subscription MAN request and answer
F Q	device handling the MASC protocol
F F	MCU in contact with Mobitex network
F G	MCU has no contact with Mobitex network
F H	MCU inform that MPAK has been sent over the radio
F K	Error message from MCU
F O	Prepare to close down MCU
F #	Short number list request and answer

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1.2 TYPE TEST FUNCTIONS

The following commands are always to be implemented in MCU.

These functions should only be used during type testing and must be made inoperative for normal use.

All requested parameters which are available in the mobile should be included in all answers to type test functions.

Type test functions consist of commands belonging to specific radio protocol.

To separate mobile terminals with different radio protocol, the following commands are available:

P-command	Used in mobile terminal at 1200bps.
K-command	Used in mobile terminal at 1200bps.
PA-command	Used in mobile terminal at 8/16kbps.
KA-command	Used in mobile terminal at 8/16bps.

1.3 TERMINAL SYSTEM FUNCTIONS

The following commands to be implemented in MCU, according to application.

F system control

1.4 AUDIO FUNCTIONS

The following commands to be implemented in MCU, according to application.

A controlling audio functions

1.5 MANUAL RADIO FUNCTIONS

The following commands to be implemented in MCU, according to application.

H controlling manual radio mode

1.6 USER COMMANDS

The following commands are free to use in applications. If used in application, contact mobile manufactor about implementation in MCU.

X
Y
Z

2 BASIC FUNCTIONS (always to be implemented in MCU)

2.1 B-command (parameters for the MASC protocol)

Structure of text field:

B	SP	len	,	int
1	1	3	1	1-4

The data field is empty.

The B-command is used to set parameters for the protocol.

len is a 3-digit ASCII coded hex number which sets the maximum length of an Information frame. This field should always be set to the maximum possible frame size, i.e. 47E (1150 decimal).

int is a maximum 4-digit ASCII coded hex number which sets the shortest time between two subsequent frames. The value is given in 10 ms increments. Default value is int = 0.

len and int are separated by a , (comma).

These parameters should be used as soon as they have been received.

The default values are used until a B-command has been received. A B-command should be the first frame sent after start up.

After receiving a B-command, the protocol should send a start_of_line signal to a higher protocol, to make clear that the connection is established and that the start sequence can follow.

Start_of_line signal is an internal signal between the link layer and higher layer.

2.2 M-command (send/receive MPAK via radio)

Structure of text field:

M	SP	sequ-id
1	1	1

SP indicate that a sequence number identity is added. If no SP then there is no sequ-id.

sequ-id is a 1-digit ASCII coded decimal number between 0 - 9. This sequence number is an identity of the MPAK.

Structure of data field:

MPAK
16-1120

MCU receiving the M-command sends MPAK via the radio path to the network. If M-command consists of a sequence number, the command FH indicating 'sent to mobitex network' is sent to terminal including the sequence number. Returned MPAK should also indicate sequence number.

MPAK received via the radio path, is sent over the interface to the terminal with the M-command (MAN is included in MPAK). The sequence number is not used in this M-command.

The received MPAK(to be sent via the radio path) should be a permitted MPAK concerning valid information in the MPAK head and MPAK length(sender, trafstate, class, packet type, size of MPAK).

Description of the different MPAKs can be found in " Network layer for terminals", see reference R1-09.

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2.3 E-command (Error command or function)

Structure of text field:

E
1

The datafield may be used to send information about the error.

The E-command informs that the previously received command or function cannot be executed. (Command or function is not implemented in the receiving unit or included parameters are not accepted).

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2.4 N-command (return of MPAK not sent)

Structure of text field:

N	SP	err-code	,	sequ-id
1	1	2	1	1

SP indicate that an error code and sequence number are added. If no SP then there is no error code or sequence number.

err-code is a 2-digit ASCII coded hex number between 00 - FF. This error code is described in chapter "Fault situation in mobitex mobile stations".

sequ-id is a 1-digit ASCII coded decimal number between 0 - 9. This sequence number is an identity of the MPAK.

Structure of data field:

MPAK
16-1120

The N-command indicates to the terminal that the MPAK has not been sent over radio (communication failure or transmission interrupted by FO or FI-command).

In manual mode MPAK's should be returned by the N-command.

The MCU can indicate the reason, of not sending the MPAK over the radio, by adding the error code.

If a sequence number is indicated in the M-command, then this sequence number should also be in the N-frame.

If no error code or sequence number is valid, this pararameter is not added.

Description of the different MPAKs can be found in " Network layer for terminals", see reference R1-09.

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2.5 R-command (return of incorrect MPAK)

When receiving the R-frame and not finding the fault, the receiving unit is supposed to make a restart by sending a B-frame.

Structure of text field:

R	SP	err-code	,	sequ-id
1	1	2	1	1

SP indicate that an error code and sequence number are added. If no SP then there is no error code or sequence number.

err-code is a 2-digit ASCII coded hex number between 00 - FF. This error code is described in chapter "Fault situation in mobitex mobile stations".

sequ-id is a 1-digit ASCII coded decimal number between 0 - 9. This sequence number is an identity of the MPAK.

Structure of data field:

MPAK
16-1120

MCU uses the R-frame to return an MPAK which was received with the M-command and which does not comply with the format and the rules set by the network and link layers of MOBITEX terminals.

The MCU can indicate the reason, of not accepting the MPAK, by adding the error code.

If a sequence number is indicated in the M-command, then this sequence number should also be in the N-frame.

If no error code or sequence number is valid, this pararameter is not added.

Description of the different MPAKs can be found in " Network layer for terminals", see reference R1-09.

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2.6 D-command (route received MPAKs to an output)

Structure of text field:

D	SP	MAN	,	UTG	,	TYP	,	SET
1	1	6	1	1	1	1	1	1

The data field is empty.

MAN is a 6-digit ASCII coded hex number stating the MAN for which MPAKs are to be routed to output UTG. MAN must be one of the possible MANs of the terminal (terminal MAN, group MAN or personal MAN).

UTG is a 1-digit ASCII-coded hex-number stating the output to which received MPAKs are to be routed.

TYP is a 1-digit ASCII-coded hex-number stating the type of MPAK which is to be routed to UTG.

SET is activating the function of set/reset these parameters.

UTG and TYP to be used as follows:

UTG =	0	default output
	1	printer
	2	audio
	3	emergency
	4	op. terminal:1 (MASC protocol)
	5	op. terminal:2
	6	op. terminal:3
	7	op. terminal:4
	8	op. terminal:5
	9	op. terminal:6
TYP =	0	no types(reset all)
	1	text
	2	data
	3	status
	4	line connection (speech)
	5	emergency
	6	all types except emergency
	7	extpak
	8	hpdata
	9	dteserv
SET =	0	set these parameters
	1	reset these parameters

After receiving the D-command, MCU will route incoming MPAKs of the specified type and intended for the specified MAN to the function block which handles the communication (formatting etc) for the specified output. Thus it is possible to route MPAKs to several outputs e.g. to both printer and op.terminal.

When receiving a D-command with UTG="default output", the MCU resets all earlier D-commands for the specified MAN and specified TYP. If for example the TYP is "all types", all earlier D-commands concerning this specified MAN are reset and all types are sent to default output connection. If TYP is "no types", then all types is reset for this MAN and UTG.

It is possible to set or reset an earlier D-command, using the parameter set or reset.

After logout, a personal subscription should be removed from this list of routing MPAKs.

When power on, MCU sets up default outputs, e.g. text, data and status to op.terminal and line connection to audio interface.

All MPAK:DTESERV is routed to output, where terminal MAN is located(can be more than one).

Description of the different MPAKs can be found in " Network layer for terminals", see reference R1-09.

2.7 S-command (sends MPAK to the specified output)

Structure of text field:

S	SP	UTG
1	1	1

Structure of data field:

MPAK
16-1120

UTG is a 1-digit ASCII-coded hex-number which states to which output MPAK is to be sent.

When receiving the S-command, MCU sends MPAK to the output stated by UTG.

The parameter UTG is to be used as follows:

UTG = 0	direct to default output
1	printer
2	audio
3	emergency
4	op. terminal:1 (MASC protocol)
5	op. terminal:2
6	op. terminal:3
7	op. terminal:4
8	op. terminal:5
9	op. terminal:6
A	
B	
C	
D	
E	
F	printer, without printing the MPAK-head

Note 1: When the parameter UTG = F, the datafield consists of printable information except the MPAK-head. The printer should ignore the MPAK-head, this means that the information starts in octet 12.

Description of the different MPAKs can be found in " Network layer for terminals", see reference R1-09.

2.8 T-command (request/transfer of emergency text).

Structure of text field, request:

T
1

Structure of data field for transfer of emergency text:

Emergency text
0 - 256

The T-command is used by the terminal to set up in MCU the dynamic text part of the emergency signal and as a request to MCU to return the stored emergency text. MCU uses the command as a reply to the request.

The emergency text field is the emergency text which is to be transferred. The emergency text can have up to 256 characters according to MOBITEX textcode. The first two octets of the text part are reserved to indicate the source of the emergency.

Source of emergency: Emergency 1 = 01
Emergency 2 = 02
Emergency 3 = 03
Emergency 4 = 04
Handset = 05
OP-terminal 1 = 06

When receiving a T-command with text part, MCU stores emergency text as the dynamic text part of a possible, future SOS packet. When receiving the T-command request, the stored emergency text is sent to the terminal by the T-command with text part.

Description of the emergency packets and procedures (SOS, SOSINFO etc) can be found in "Network layer for terminals", see reference R1-09.

2.9 U-command (send emergency signal SOS)

U
1

The U-command is used by the terminal to initiate the transmission of an emergency signal (SOS packet).

When receiving the U-command, MCU creates a SOS packet and sends it to the network. The text part of SOS is made up by the stored emergency text (received earlier by the T-command) where the identity of the emergency source is inserted as the first two octets.

Description of the emergency packets and procedures (SOS, SOSINFO etc) can be found in "Network layer for terminals", see reference R1-09.

When MCU is in manual mode, it is recommended that the MCU return to MOBITEX operating mode and sends tha packet MPAK:SOS.

2.10 F P-command (MAN request)

The FP-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.11 F Q-command (device handling the MASC protocol)

The FQ-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.12 F F-command (MCU in contact with mobitex)

The FF-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.13 F G-command (MCU not in contact with mobitex)

The FG-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.14 F H-command (MPAK sent over radio path)

The FH-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.15 F K-command (error message from MCU)

The FK-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.16 F O-command (prepare to close down)

The FO-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.17 F #-command (short number list)

The F#-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

3 TYPE TEST FUNCTIONS (always to be implemented in MCU)

These functions should only be used during type testing and must be made inoperative for normal use.

3.1 P-command (request/list of parameters)

Structure of text field in request for internal parameters from terminal to MCU:

P
1

Structure of text field in reply from MCU to terminal (list of parameters):

P	SP	list of parameters
1	1	>=1

The data field is empty.

The P-command is used by the terminal to request radio protocol parameters and by MCU to send these parameters as a reply to the request.

The list of parameters consists of a number of ASCII coded hex numbers separated by , (comma). The parameters to be sent in the following order:

Parameter	No of bytes
Slot_length	1
Timeout_short	1
Timeout_long	1
Free_slots	1
Rand_slots	1
Current_base (internal parameters in MCU)	2
Chosen_slot (internal parameters in MCU)	1
Max_access	1
Max_rep	1
Priority (internal parameter in MCU)	1
Sequential number up (term.MAN)	1
Sequential numbers down (term.MAN+15 groups)	16
Upfreq (current)	2
Dofreq (current)	2
Flexlist (MAN 1 - 7)	21
Grouplist (MAN 1-15)	45

The meaning and structure of the different parameters can be found in "Data link layer for terminals", see reference R1-16.

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3.2 PA-command (request/list of radio-parameters)

Structure of text field in request for internal parameters from terminal to MCU:

PA01
4

Structure of text field in reply from MCU to terminal (list of parameters):

PA01	SP	list of parameters
4	1	>=23

The data field is empty.

The PA-command is used by the terminal to request radio protocol parameters and by MCU to send these parameters as a reply to the request.
The list of parameters consists of a number of ASCII coded hex numbers separated by , (comma). If a parameter is not available or not given, this parameter is not included. The parameters to be sent in the following order:

Parameter	No of bytes
Timeout	1
Slot_length	1
Free_slots	1
Rand_slots	1
Max_rep	1
Max_access	1
Max_speech	1
Txpow	1
Slev1	1
Slev2	1
Scan_time	1
Bad_base	1
Good_base	1
Choose_base	1
Better_base	1
Qpos	1
Current_base (internal parameter in MCU)	2
Chosen_slot (internal parameter in MCU)	1
Priority (internal parameter in MCU,current value)	1
Upfreq (current value)	2
Dofreq (current value)	2
Access_channel_upfreq (current value)	2
Access_channel_dofreq (current value)	2
Network_id (mobile tx)	2
Network_id (mobile rx)	2
Area_id	1

Example of PA01-command:

```
    MCU                                     TERMINAL
                            <--------       PA01
    PA01 01,02,03,04,05,06,07,08,09,10,11,12,13,14,15,16,0017,
         18,19,0020,0021,0022,0023,0024,0025,26
                            -------->
```

or

```
    PA01 01,02,03,04,,,,,,,,,,,,,,,,,,,,,,26
                            -------->
```

The meaning and structure of the different parameters can be found in "Data link layer for terminals", see reference R1-16.

3.3 PA-command (request/list of identity-parameters)

Structure of text field in request for identity parameters from terminal to MCU:

PA02
4

Structure of text field in reply from MCU to terminal (list of parameters):

PA02	SP	list of parameters
4	1	>=40

The data field is empty.

The P-command is used by the terminal to request radio protocol parameters and by MCU to send these parameters as a reply to the request.

The list of parameters consists of a number of ASCII coded hex numbers separated by , (comma). If a parameter is not available or not given, this parameter is not included. The parameters to be sent in the following order:

Parameter	No of bytes
Terminal MAN	3
ESN	4
Flexlist (MAN 0 - 7)	21
Grouplist (MAN 1-15)	45
Sequential number up (term.MAN)	1
Sequential numbers down (term.MAN+15 groups)	16

Example of PA02-command:

```
    MCU                              TERMINAL
                       <--------     PA02
    PA01 000001,00000002,000003,000004,000005,,,,,000010,,,,,
         ,,,,,,,,,,26,27,,,,,,,,,,,,,,,42
                       -------->
```

The meaning and structure of the different parameters can be found in "Data link layer for terminals", see reference R1-16.

3.4 PA-command (request/list of channel-parameters)

Structure of text field in request for parameters from terminal to MCU:

PA03
4

Structure of text field in reply from MCU to terminal (list of parameters):

PA03	SP	list of parameters
4	1	>=4

The data field is empty.

The P-command is used by the terminal to request radio protocol parameters and by MCU to send these parameters as a reply to the request.

The list of parameters consists of a number of ASCII coded hex numbers separated by , (comma). If a parameter is not available or not given, this parameter is not included. The parameters to be sent in the following order:

Parameter	No of bytes
Channel_list (current)	1
Number_of_channels in channel_list (total)	2
Number_of_channels in this command	1
Channel #1 - upfreq	2
Channel #1 - dofreq	2
Channel #2 - upfreq	2
Channel #2 - dofreq	2
.	
.	

Channel-list = 01(hex) DEFAULT_LIST
02(hex) CURRENT_LIST
03(hex) TEMP_DEFAULT_LIST

All parameters in this command is a number of ASCII coded hex number.

Example: Answer with a default list of 100 channels.

PA03 01,0064,3C,0123,0123,.......
PA03 01,0064,28,0123,0123,.......

The meaning and structure of the different parameters can be found in "Data link layer for terminals", see reference R1-16.

3.5 PA-command (request/list of roaming-parameters)

Structure of text field in request for parameters from terminal to MCU:

PA05
4

Structure of text field in reply from MCU to terminal (list of parameters):

PA05	SP	list of parameters
4	1	>=4

The data field is empty.

The ~~P-command~~ is used by the terminal to request radio protocol parameters and by MCU to send these parameters as a reply to the request.

The list of parameters consists of a number of ASCII coded hex numbers separated by , (comma). If a parameter is not available or not given, this parameter is not included. The parameters to be sent in the following order:

Parameter	No of bytes
Number of bases in table	1
Current_base_id	2
roaming_value	1
Base_id	2
roaming_value	1
.	
.	
.	

Example: Mobile terminal with current_base(23) choosen.

PA05 03,0023,09,0025,02,0019,04

Mobile terminal with no choosen current_base.

PA05 03,,,0023,02,0019,01

The meaning and structure of the different parameters can be found in "Data link layer for terminals", see reference R1-16.

3.6 PA-command (request/list of test-parameters)

Structure of text field in request for parameters from terminal to MCU:

PA06	SP	function	,	parameter
4	1	2		>= 0

Structure of text field in reply from MCU to terminal (list of parameters):

PA06	SP	function	,	list of parameters
4	1	2	1	>=1

The data field is empty.

The P-command is used by the terminal to request for radio protocol parameters and by MCU to send these parameters as a reply to the request.

The function is a ASCII coded decimal number between 00 - 99, describing separate request or answer. Those functions are described below.

The list of parameters consists of a number of ASCII coded hex numbers separated by , (comma). If a parameter is not available or not given, this parameter is not included. The parameters to be sent in the following order:

Function:

No:	description:	parameter:
01	current_base(Req/ans)	In the answer, the current_base is in ASCII coded hex number.
02	set current_base	Current_base in ASCII coded hex number.
03	disable base_search_mode	-
04	enable base_search_mode	-
05	clear dynamic memory	-
06	enable copy REPMAP when receiving or sending the frame <REB>	An ASCII coded hex number for each bit set to "1" indicating repetition in the frame <REB>. A comma is placed between each number.
07	disable copy REPMAP	-
08	enable loudspeaker	-
09	disable loudspeaker	-

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No:	description:	parameter:
10	copy NUMRET	The parameter NUMRET in ASCII coded hex number, stating the number of retransmissions.
11	enable transmitting the scrambling signal over the radio(see ref R1-17)	-
12	disable transmitting the scrambling signal over the radio(see ref R1-17)	-
13	copy speech parameters.	Subscriber, con-id, upfreq, dofreq. Parameters in ASCII coded hex number separated by a comma.

Example:

MCU		Terminal
	<-------	PA6 01
PA6 01,1234	------->	
	<-------	PA6 02,1234
	<-------	PA6 06
PA6 06,6,23,35	------->	
	<-----	PA6 07
	<-----	PA6 08
	<-----	PA6 09
	<-----	PA6 10
PA6 10,12	------>	
	<-----	PA6 12
	<-----	PA6 11
	<-----	PA6 13
PA6 13,123456,12,1111,2222	------->	

The meaning and structure of the different parameters can be found in "Data link layer for terminals", see reference R1-16.

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3.7 K-command (receive/transmit frequency number)

Structure of text field to frequency number reception:

KM	SP	parameter
2	1	3

Structure of text field to frequency number transmission:

KS	SP	parameter
2	1	3

The data field is empty in both commands.

The parameter ~~field~~ states the frequency number. The number is given as the ASCII codes of the hexadecimal digits of the frequency number in hexadecimal notation.

The K-command is used to set up the frequency pair to be used for reception and transmission. The frequency number range is hexadecimal 001 - 617 (decimal 0001 - 1559).

If the frequency number included in the frame is not implemented in the equipment, MCU will respond with an E-frame (error function).

For correspondence between frequency number and frequency, see reference R1-06 .

3.8 KA-command (receive/transmit frequency number)

Structure of text field to frequency band:

KAB	SP	FBI
3	1	1

Structure of text field to frequency number reception:

KAM	SP	parameter
3	1	4

Structure of text field to frequency number transmission:

KAS	SP	parameter
3	1	4

The data field is empty in all commands.

The parameter FBI states the frequency band and bitrate. The parameter is given as the ASCII coded hex number of the parameter FBI in upfreq and dofreq.

The parameter field states the frequency number. The number is given as the ASCII codes of the hexadecimal digits of the frequency number in hexadecimal notation.

The KA-command is used to set up the frequency pair to be used for reception and transmission. The frequency number range is hexadecimal 0001 - 1FFF (decimal 0001 - 8191).

If the frequency number included in the frame is not implemented in the equipment, MCU will respond with an E-frame (error function).

For correspondence between frequency number and frequency, and frequency band(FBI) and bitrate , see reference R1-06.

4 TERMINAL SYSTEM FUNCTIONS (implemented according to application)

4.0 F-command (system control)

The F-command is used from op. terminal to execute the specified function in MCU.
The F-command is used by MCU to send information to the terminal.

Structure of the text field:

F	SP	list of parameters
1	1	>=1

The data field is used only in the FT- and F#-frame with list of channel numbers and short numbers.

The list of parameters is a list of one-character function codes and parameters in ASCII code according to the following table:

4.1 F B Change to MOBITEX operation mode
MCU sends an ACTIVE packet to the network

4.2 F C Set up a MOBITEX line connection
parameters MAN1,MAN2
MAN is a 6-digit ASCII-coded hex-number.
MAN1=sender, MAN2=addressee.
MCU creates and sends a CONREQ packet to the network.

4.3 F D Set up a TELEPHONE line connection
Parameters MAN,TEL
MAN is a 6-digit ASCII-coded hex-number (sender).
TEL is the desired number in the telephone network.
The number is given in MOBITEX textcode, right justified in a 20 character field with leading spaces according to the corresponding field of EXTCONREQ.
MCU creates and sends an EXTCONREQ packet to the network.

4.4 F E Disconnect line connection
MCU creates and sends a DISCON packet to the network.

4.5 F F Contact with the MOBITEX network
MCU is in contact with the MOBITEX network.

4.6 F G No contact with MOBITEX network
MCU has no contact with the MOBITEX network and is trying to establish contact again (roaming procedure started).

4.7 F H MPAK sent by the radio to the network
Parameter SEQU-ID
MCU inform that MPAK has been sent to the network. The parameter SEQU-ID is added if SEQU-ID was included in the M-command. SEQU-ID is a 1-digit ASCII coded decimal number between 0 - 9.

4.8 F I Cancell previously transmission of MPAK
Previously activated transmission of MPAK is cancelled. The MPAK to be returned to the terminal by an N-frame.

4.9 F J Print out current MANs in terminal
Print current MANs in terminal on printer (terminal subscription MAN, group MANs (group_list) and personal subscription MANs (flex_list) in that order.

4.10 F K Error message about a fault situation
Parameter XX
Error message where XX is the error number in ASCII coded hex digits 00-FF (0-255).
Information from MCU about a fault situation.
Description of the meaning fault situation see chapter "Fault situation in mobitex mobile stations".

4.11 F L Activate external call indication
Activate external indication (e.g. horn) for 2 seconds.

4.12 F M Transmitter on/off
Parameter X
X = character 0 ---> transmitter off
X = character 1 ---> transmitter on

4.13 F N Change to MANUAL RADIO mode
MCU sends an INACTIVE packet to the network.

4.14 F O Prepare for closing down MCU
From terminal: Command to prepare closing down (switching off) the MCU.
MCU clears buffers for stored MPAKs. MPAKs to be transmitted to the network are transmitted. All other MPAKs are sent to the terminal. If no contact with the network, MPAK's to the network are returned by the N-command.
Then MCU sends an INACTIVE packet to the network.
Finally MCU confirms that it is empty by sending a FO-frame to the terminal.
From MCU: MCU is empty and ready to be switched off.

Note: If more than one device connected, the FO-command from the MCU should be sent to all devices.

4.15 F P Terminal MAN request/answer
Request from terminal for terminal subscription MAN.

F PXXXXXX Terminal subscription MAN from MCU to terminal as response to the request. XXXXXX is the MAN as a 6 digit ASCII coded hex number.

4.16 F Q MASC device identity
Parameter XXX
Type of device handling the MASC protocol.
F_Q(MASC_DEVICE) is information to other units connected to this MASC interface.
XXX = MCU
XXX = MOX

4.17 F R Change network identification
Parameters XXXX,YYYY
Send this new network identification to data link layer(see reference R1-16).
XXXX = is new network_ID for mobile tx in ASCII coded hex number.
YYYY = is new network_ID for mobile rx in ASCII coded hex number.

4.18 F S Change AREA-LIST
Parameters BITMAP,COM
Send this new area list to data link layer(see reference R1-09 and R1-16).
BITMAP = see AREALIST reference R1-09.
COM = see Command reference R1-09.
Parameters BITMAP and COM is in ASCII coded hex digits.

4.19 F T Change TEMP_DEFAULT_LIST
Parameters TNUM,NUM,M
Send this new channel list to data link layer(see reference R1-09 and R1-16).
TNUM = Total number of channels. If TNUM is zero, delete TEMP_DEFAULT_LIST and return to DEFAULT_LIST.
NUM = Number of channels in this command
M = 0 No more channels
M = 1 More channels in next command.
Parameters TNUM, NUM and M is in ASCII coded hex digits.
The list itself is sent in the data field of the frame. The list is described in reference R1-16.

4.20 F V Speech queue information
Parameter XX
Information about queue-position when waiting for speech to be connected.
XX is the speech-queue number in ASCII coded hex digits in the range 00-FF.

4.21 F # Short number list
Request from terminal for short number list.

F #XX List of short numbers from MCU or terminal. The list contains short numbers which are common to MCU and all connected terminals (general short numbers). It is sent by the terminal to set up this list and by MCU as a reply to the F# request frame from the terminal.
XX is the number of short numbers in the list in ASCII coded hex digits in the range 00-32 (0-50 decimal).
The list itself is sent in the data field of the frame. In the list, the actual numbers corresponding to each short number from 1 and up are given as ASCII coded digits with a maximum of 20 digits each. The numbers are separated by the character , (comma).

NOTE: Only the 'one-character function' can be included in an F-command, e.g. F P123456.

Description of the different packets and procedures mentioned here can be found in reference R1-09 and R1-16.

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5 **AUDIO FUNCTIONS (implemented according to application)**

5.0 A-command (controlling audio functions).

Structure of text field:

A	SP	list of parameters
1	1	>=1

The data field is empty.

The A-command is used to control the audio equipment.

The list of parameters is a list of one-character function codes and parameters in ASCII code according to the following table:

5.1 A B Increase audio volume level

5.2 A C Decrease audio volume level

5.3 A D Loudspeaker on/off
Parameter X
X = character 0 --> off
X = character 1 --> on

5.4 A E External call indication on/off
Parameter X
X = character 0 --> off
X = character 1 --> on

5.5 A H Microphone (hook) on/off
Parameter X
X = character 0 --> off
X = character 1 --> on

5.6 A I Transmit/receive switch
Parameter X
X = character 0 --> transmit
X = character 1 --> receive

5.7 A J Hands free.
Parameter X
X = character 0 --> off
X = character 1 --> on

5.8 A V Audio level order.
Parameter X
X=data, ASCII coded hex digit 0-F.

NOTE: Only the 'one-character function' can be included in an A-command, e.g. A E0.

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6 MANUAL RADIO MODE FUNCTIONS (implemented according to application)

6.0 H-command (controlling manual radio mode)

Structure of text field:

H	SP	list of parameters
1	1	>=1

The data field is empty.

The H-command is used to control the radio equipment when in manual radio mode.

The list of parameters field is a list of one-character function codes and parameters in ASCII code according to the following table:

6.1 H A Change to MOBITEX mode.
MCU sends an ACTIVE packet to the network.

6.2 H B Increase audio volume level.

6.3 H C Decrease audio volume level.

6.4 H D Loudspeaker on/off.
Parameter X
X = character 0 --> off.
X = character 1 --> on.

6.5 H E External call indication on/off.
Parameter X
X = character 0 --> off.
X = character 1 --> on.

6.6 H F Call indication
Parameter X
X = character 0 --> no call received
X = character 1 --> call received

6.7 H G Squelch open/closed (toggle).

6.8 H H Microphone (hook) on/off.
Parameter X
X = character 0 --> off.
X = character 1 --> on.

6.9 H I Transmit/receive switch
Parameter X
X = character 0 --> transmit
X = character 1 --> receive

6.10 H J Hands free.
Parameter X
X = character 0 --> transmit
X = character 1 --> receive

6.11 H K Change to channel number.
Parameter XX
Change to channel number XX where XX is the desired channel number in ASCII coded hex digits in the range 01-63 (1-99 decimal).

6.12 H L Channel number indication.
Parameter XX
XX is the channel number in ASCII coded hex digits in the range 01-63 (1-99 decimal). Will be sent whem start up or a changed channel occur.

6.13 H M Send selective call number.
Parameter XXXXXXX
Send selective call number XXXXXXX on current channel.
X is an ASCII coded digit 0-9.
If the number of digits is less than 7, the number will be left justified and the XXXXXXX-field will be filled with trailing spaces (hex code 20).

6.14 H N Scan the specified channels.
Parameter XX..XX
XX..XX is a list of maximum 8 channel numbers in a field of 16 octets. Each XX represents a channel number in ASCII coded hex digits in the range 01-63 (1-99 decimal). If the number of channels is less than 8, the field will be filled with trailing spaces (hex code 20).
The specified channels are scanned for carrier or selective call.

6.15 H O Carrier indication.
Parameter X
The frame must be transmitted only when there is a change between sensing carrier and sensing no carrier. The carrier sense itself should be updated at least once per second.
X = character 0 --> no carrier
X = character 1 --> carrier

6.16 H P Copy of own selective number.
Parameter XXXXXXX
Copy of the own selective call number.
X is an ASCII coded digit 0-9.
If the number of digits is less than 7, the number will be left justified and the XXXXXXX-field will be filled with trailing spaces (hex code 20).

6.17 H Q Transmit/receive indicator
Parameter X

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```
X = S ---> transmitting (sending)
X = M ---> receiving (monitoring)
```

Note: Only the 'one-character function' can be included in an H-command, e.g. H P1234567.

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7 Signalling between MCU and terminal equipment connected to the MASC interface.

7.0 General

These chapters have been included because the network layer may be differently implemented in different terminal equipment. For any terminal equipment, connected to MCU via the MASC interface, the MCU can be considered as a DCE for connection to the MOBITEX network. A terminal can have a complete MOBITEX network layer or a simplified network layer, using different commands of the MASC protocol.

A terminal connected to the MCU must have the same terminal MAN number as the MCU.

The terminal MAN must be associated to at least one output connection, either a MASC interface or another connection (e.g. a handset or a printer).

All messages to groups, belonging to terminal MAN, should be directed to the same output connection(s) as terminal MAN.

The MCU has the responsibility towards the MOBITEX network according to the network layer.

In order to get the MOBITEX network layer in MCU and the terminal to interact correctly, the following chapters have to be considered.

7.1 MPAK received from the network

ROAMORD, FLEXREQ,INFOREQ and ESNREQ will be completely handled within the MCU without notifying any connected terminal.

DIE and LIVE will be completely handled within the MCU but notified by FK-command(if handled) to connected terminals.

All other correctly received MPAKs will, after normal handling in the MCU, be sent to the output connection where the addressed MAN is located.

A fixed terminal can't receive a CONORD, therefore CONORD is to be converted to a CONREQ by the MCU.

7.2 MPAK received from a terminal

Normally, if the MPAK passes the checks in the MCU, the MPAK will be sent to the network. The MCU should react and enter states as if the MPAK was generated in the MCU (e.g. on CONREQ the MCU should enter a state for call in progress, and should also act according to the radio protocol for sending such MPAK).

If the checks fail, the MPAK should be returned to the terminal by an R-frame.

For the following MPAK's, however, the MCU should have a special treatment.

CONREA	to be treated as a hook off-signal
DISCON	to be treated as a hook on-signal
FLEXREQ	if the personal subscription already exist ~~in flex~~list the terminal will be informed by FK-frame.
FLEXLIST	to be returned to the terminal by an R-frame.
BORN, ROAM, INFO, ESNINFO	to be returned to the terminal by an R-frame.
LINEON, LINEOFF	to be returned to the terminal by an R-frame.

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7.3 Connection between the MCU and the terminal

The terminal is supposed to have a list of groupMAN's and a list of personal subscriptions (flexlist). In order to get the lists in the MCU equivalent to the list in the terminal, the following should be considered.

Each time the link layer connection is established (by exchange of B-frames), the terminal will send:

- MANREQ (command F P) to request MCU for the terminal MAN

To answer this, the MCU sends the terminal MAN in the command MAN (command F P). This answer should be sent immediately or, if another frame is currently being transmitted by the MCU, immediately after the transmission is completed. After that, the MCU will send the MASC_DEVICE command (F Q).

The MCU should send:

- GROUPLIST to set the list of groupMAN in the terminal
- FLEXLIST to set the flexlist in the terminal.

The terminal will then handle the flexlist according to the specification, see R1-09.

Example of start sequence when MCU starts.

```
MCU                                  TERMINAL

B-frame              ------->
                     <-------        MANREQ-frame
MAN-frame            ------->
MASC_DEVICE-frame    ------->
- - - - - - - - - - - - - - - - - - - - - - - - -
GROUPLIST            ------->
FLEXLIST             ------->
```

Example of start sequence when TERMINAL starts:

```
MCU                                  TERMINAL

                     <-------        B-frame
                     <-------        MANREQ-frame
MAN-frame            ------->
MASC_DEVICE-frame    ------->
- - - - - - - - - - - - - - - - - - - - - - - - -
GROUPLIST            ------->
FLEXLIST             ------->
```

<u>Note:</u> Packets above the dotted line in each sequence belong to the link layer, and packets below the dotted line belong to the network layer.

7.4 Signalling between MCU and more than one terminal

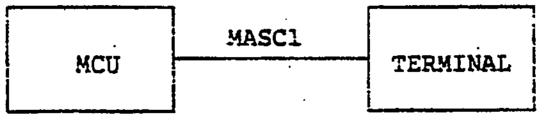
The MCU may have more than one MASC interface.

All MASC interfaces should have the same start sequence as described in chapter "Connection between the MCU and the terminal".

The MCU handles all MPAKs and messages to different output connections where the MAN is located.

7.5 Description of a system with MASC interface.

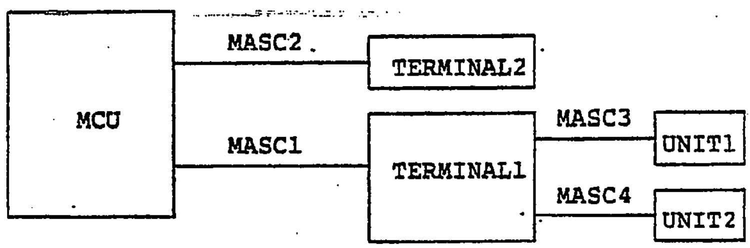
7.5.1 MCU connected to one terminal.



MCU handles the terminal MAN, group MAN and personal MAN with GROUPLIST and FLEXLIST in the start sequence.

After the start sequence, all MPAKs are routed to the terminal.

7.5.2 MCU connected to two terminals.



MCU handles the terminal MAN, group MAN and personal MAN with GROUPLIST and FLEXLIST in the start sequence.

All terminals that have other terminal equipment connected, will have the same start sequence as described in chapter "Connection between the MCU and the terminal". These terminals should be considered as an MCU by the connected units.

After the start up sequence all MPAKs are routed to the current terminal.

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Examples of start sequences.

EXAMPLE 1.

Lists when MAN are correct and MCU starts.

```
TERMINAL2   MCU                    TERMINAL1   UNIT1   UNIT2

            B-frame        ----->
                           <-----  MANREQ
            MAN            ----->
            MASC_DEVICE    ----->
      <---- B-frame
 MANREQ --->
      <---- MAN
      <---- MASC_DEVICE-frame
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      <---- GROUPLIST
            GROUPLIST      ----->
      <---- FLEXLIST
            FLEXLIST       ----->

                                   GROUPLIST ---->
                                   GROUPLIST ------------>
                                   FLEXLIST  ---->
                                   FLEXLIST  ------------>
```

Note: Packets above the dotted line in the sequence belong to the link layer, and packets below the dotted line belong to the network layer.

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EXAMPLE 2

MAN1 is only in UNIT1 and TERMINAL1. MAN2 is only in MCU. MAN1 and MAN2 are personal subsciptions not included in MCU's flexlist.

```
TERMINAL2    MCU                     TERMINAL1    UNIT1    UNIT2

             B-frame          ---->
                              <---- MANREQ
             MAN              ---->
             MASC_DEVICE      ---->
      <---   B-frame
 MANREQ -->
        <--- MAN
        <--- MASC_DEVICE-frame
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
        <--- GROUPLIST
             GROUPLIST        ---->
        <--- FLEXLIST
             FLEXLIST         ---->

                                     GROUPLIST---->
                                     GROUPLIST------------>
                                     FLEXLIST ---->
                                     FLEXLIST ------------>
```

Note 1: The terminal/unit1/unit2 will replace former lists with these new lists. When replacing the flexlist the terminal/unit1/unit2 will decide if MAN1 and MAN2 are connected or disconnected. If connected, a loginreq is sent from MAN1 in unit1 and a loginreq sent from MAN2 in unit2. If not connected an presentation of the logout is sent to the user.

Note 2: The application in UNIT1 has to send LOGINREQ for MAN1 if it wishes to keep MAN1.

Note 3: Packets above the dotted line in the sequence belong to the link layer, and packets below the dotted line belong to the network layer.

```
MOBITEX    MCU         TERMINAL1            UNIT1      UNIT2
                                   <----    LOGINREQ
                                            for MAN1

           <-----------LOGINREQ
                       for MAN1

    <------LOGINREQ
           for MAN1

LOGINGRA---->
for MAN1

           LOGINGRA---->
           for MAN1

                       LOGINGRA  ---->
                       for MAN1
```

EXAMPLE 3.

TERMINAL1 is starting the connection.

```
TERMINAL2   MCU                  TERMINAL1   UNIT1    UNIT2

                          <----- B-frame
                          <----- MANREQ
            MAN            ----->
            MASC_DEVICE   ------>
                                 B-frame   ---->
                                           <----  MANREQ
                                 MAN       ---->
                                 MASC_DEVICE---->
                                 B-frame   --------->
                                           <--------  MANREQ
                                 MAN       --------->
                                 MASC_DEVICE--------->
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      <----  GROUPLIST
             GROUPLIST    ----->
      <----  FLEXLIST
             FLEXLIST     ----->

                                 GROUPLIST---->
                                 GROUPLIST----------->
                                 FLEXLIST ---->
                                 FLEXLIST ----------->
```

Note: Packets above the dotted line in the sequence belong to the link layer, and packets below the dotted line belong to the network layer.

7.6 Fault situation in mobitex mobile stations.

This is a recommendation of error message from the MCU to the connected unit using a MASC interface. This error message is a response for a fault situation and sent as an error number in the FK-command(see chapter "Information frame commands and functions").

Error numbers 0 - 4F is reserved for specific meaning. Error numbers 50 - FF is free to use.

New meaning of error numbers is described in R1-06.

Error no:	meaning:	
0	reserved	
1	DIE mode.	An MPAK:DIE is received. No user traffic can be sent from the MCU.
2	LIVE mode.	An MPAK:LIVE is received..User traffic can be sent from the MCU.
3	SPEECH mode.	The MCU is in speech mode and can not send any traffic except MPAK:CSUBCOM.
4	MANUAL mode.	The MCU is in the manual mode and not in contact with mobitex network.
5	reserved	
6	reserved	
7	reserved	
8	reserved	
9	reserved	
A	Receiver buffer full, waiting for free buffer.	
B	Buffer/memory free.	
C	No memory, waiting for more memory.	
D	reserved	
E	reserved	
F	reserved	

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Error no:	meaning:
10	Returned MPAK during die mode.
11	Returned MPAK during speech mode.
12	Returned MPAK during manual mode.
13	Returned MPAK during buffer full.
14	reserved
15	reserved
16	Loginrequest MAN already exist in the flexlist.
17	Loginrequest MAN is not possible, flexlist is full.
18	MPAK sender MAN is not in TMAN or flexlist.
19	reserved
1A	reserved
1B	reserved
1C	reserved
1D	reserved
1E	reserved
1F	reserved
20 - 4F	reserved

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8 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 27, 28, 45
R1-09, 9, 11, 12, 14, 15, 16, 17, 31, 32, 39
R1-16, 19, 21, 22, 23, 24, 26, 31, 32
R1-17, 26

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05	References
R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

Prepared: ET/SYS PES	Subject responsible: ET/SYS PES	No: 1/1056 - A 296 5175 Ue
Approved: ET/SYSC STT STT		Date: 1990-02-23 · Rev: B · File: MTS19B.1
Cantel Mobitex™		Title: MOBITEX Terminal Specification Other interfaces, mobile terminal APPENDIX B, Application example

APPLICATION EXAMPLE

OF HOW TO MAKE AN ALTERNATE CONNECTION VIA MCU

FOR FIXED TERMINALS WITH MASC INTERFACE.

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1 INTRODUCTION

This document describes an example (i.e. not a specification) of an MCU application. Its purpose is to make it easier for the manufacturers. For the understanding of this document, the reader has to be well informed about the Network layer for terminals (reference R1-09) and Link layer for mobile terminals (reference R1-16).

A fixed terminal may be directly connected to the MOBITEX network via a masc interface (MASC) see document "Other interfaces" and appendix A "Commands". The application in this document describes how such a terminal may be connected via an MCU, that handles the masc interface. As to the requirements of such a terminal, please refer to chapter 7 in this document.

2 MCU WITH APPLICATION

Figure 1 shows an MCU with its processes. Each process communicates with the other processes as is indicated by the arrows in the figure.

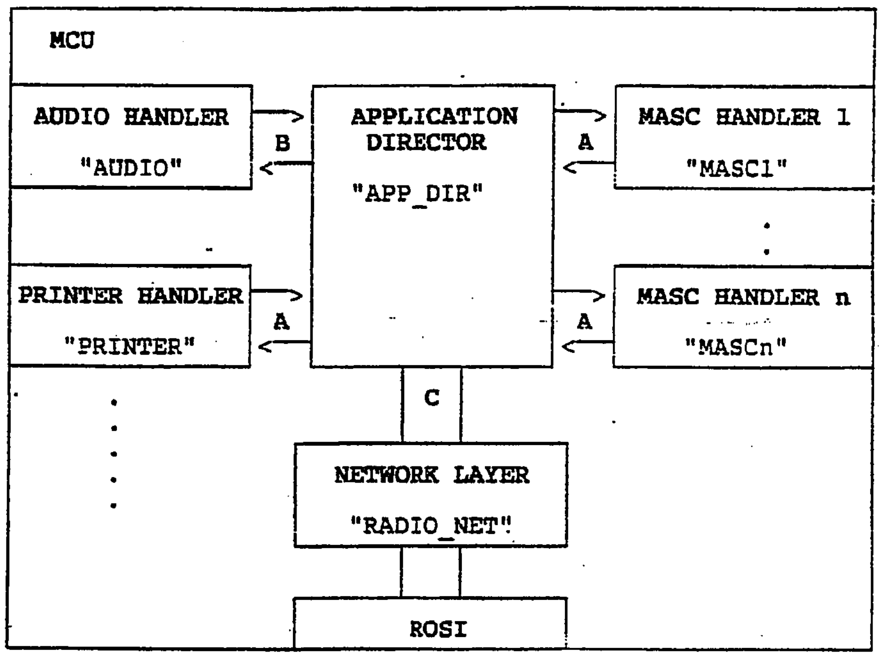

FIGURE 1

In the centre of figure 1 is a process called APP_DIR, application director. This document will describe that process.

Each MASC handler (MASC1 to MASCn) handles a masc interface.

The audio handler (AUDIO) handles an audio interface.

The printer handler (PRINTER) handles a printer, connected to the MCU.

Furthermore one may have "emergency handler", "terminal with small display handler" etc.

The network layer (RADIO_NET) is a normal MOBITEX network layer for mobile terminal, plus the additions made in chapter 7 (Requirements on network layer in MCU in this application).

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The letters A, B and C represent different signalling sequencies. Observe that the MASC handler and the printer handler acts similarly towards the application director. All handlers act in the same way as an MASC handler towards the application director.

Following terms are used in this document:

- line handler	common name for all handlers. E.g. MASC1, MASC7, AUDIO ...
- MCU_MAN	the mobile terminal's MOBITEX subscription number.

3 DESCRIPTION OF SIGNALS

All signals that are handled by APP_DIR have the following structure:

origin	Original sender. Can be: line handler, RADIO_NET or APP_DIR.
from	Sender. Can be : line handler, RADIO_NET or APP_DIR.
signal_status	Signal status can be signal_status_ok or signal_status_not_sent. Signal status is always set to signal_status_ok when the signal is created. If the RADIO_NET or any of the line handlers fails to transmit a signal, signal status will be set to signal_status-_not_sent. Then the signal is returned to APP_DIR.
signal_type	Can be: S_hook_on, S_hook_off, S_MPAK, S_MPAK_sent_on_radio, S_returned_incorrect_MPAK, S_not_sent_MPAK S_line_up, S_line_down.
(MPAK)	If signal_type is S_MPAK, S_not_sent_MPAK or S_returned_incorrect_MPAK, it contains an MPAK in this field.

Description of the signal types:

S line up
S_line_up is sent by all line handlers to APP_DIR after a correct start or restart.

If the line handler is an MASC_handler, the starting up sequence will send a PRIM_MASC_frame and an acknowledgement of this will be received from the connected unit before S_line_up may be sent.

If the line handler is a PRINTER, it is recommended that S_line_up is not sent until the modem signals say there is a printer connected.

S line down
S_line_down is sent by all line handlers to APP_DIR when the unit is disconnected.

If the line handler fails to transmit a signal to the connected unit, S_line_down will be sent to APP_DIR together with the signal being returned.

S MPAK
S_MPAK is the normal signal being sent between line handler and APP_DIR and between RADIO_NET and APP_DIR. In the normal case, signal status is signal_status_ok. But in the case when line handler or RADIO_NET fails to transmit the signal, signal status will be set to signal_status_not_sent and the signal will be returned to APP_DIR. For further information see examples below (chapter 4).

When an S_MPAK is received by the MASC-handler, the MASC-handler must send an M-frame to the connected unit according to the masc protocol.

When an M-frame is transmitted from the connected unit to the MASC-handler, the MASC-handler must send an S_MPAK to APP_DIR.

S returned incorrect MPAK.
S_returned_incorrect_MPAK is sent by APP_DIR to line handler if an incorrect MPAK was received.

If an MASC handler receives a S_returned_incorrect_MPAK, this MPAK will be sent to the connected unit in an R-frame according to the masc protocol.

S not sent MPAK.

S_not_sent_MPAK is sent by APP_DIR to line handler if, for some reason, it is impossible to transmitt a mpak on radio.

If an MASC handler receives a S_not_sent_MPAK, this MPAK will be sent to the connected unit in an N-frame according to the masc protocol.

S MPAK sent on radio

S_MPAK_sent_on_radio is sent by RADIO_NET to APP_DIR when an MPAK has been sent via radio. Origin helps APP_DIR to direct this signal to correct line-handler. When the MASC handler receives an S_MPAK_sent_on_radio, it uses the masc F_H-frame to send the signal to connected unit.

S hook off

S_hook_off is sent by AUDIO to APP_DIR at hook off. APP_DIR updates its registers and passes the signal on to RADIO_NET.

An MPAK CONREA, received by APP_DIR from connected unit, will not be sent to RADIO_NET. Instead S_hook_off will be sent from APP_DIR to RADIO_NET.

S hook on

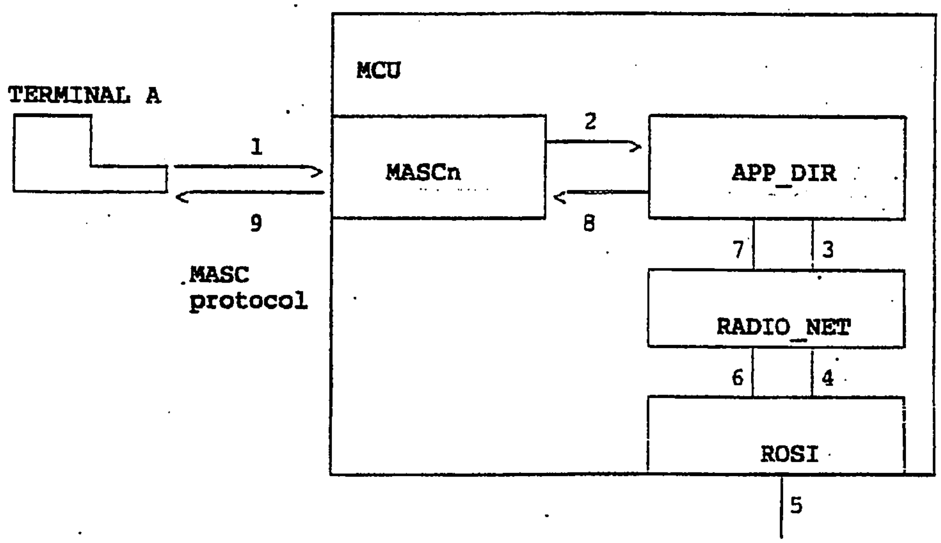
S_hook_on is sent by AUDIO to APP_DIR at hook on. APP_DIR updates its registers and passes the signal on to RADIO_NET.

An MPAK DISCON, received by APP_DIR from connected unit, will not be sent to RADIO_NET. Instead S_hook_on will be sent from APP_DIR to RADIO_NET.

4 EXAMPLES OF SIGNALLING IN THIS APPLICATION

4.1 EXAMPLE 1: sending TEXT successfully

Unit A sends an MPAK TEXT to a subscriber B in the MOBITEX network. Transmission via radio is successful.



signal	signal_type	origin	from	signal_status
1	masc frame M			
2	S_MPAK	MASCn	MASCn	signal_status_ok
3	S_MPAK	MASCn	APP_DIR	signal_status_ok
4 - 6 are not handled in this document.				
7	S_MPAK_sent_on_radio	MASCn	RADIO_NET	signal_status_ok
8	S_MPAK_sent_on_radio	MASCn	APP_DIR	signal_status_ok
9	masc frame F_H			

Observe that origin = MASCn through the whole sequence. This gives APP_DIR an opportunity to route signals easier back to the sender.

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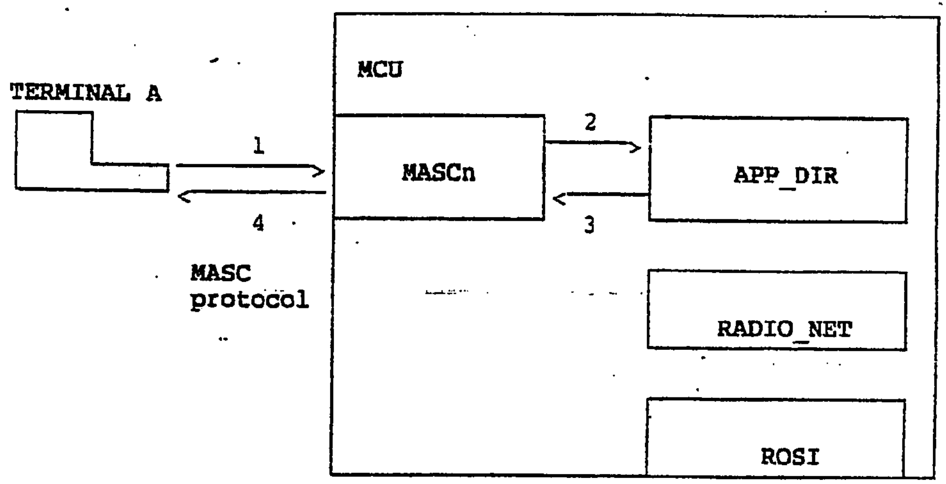
4.2 EXAMPLE 2: sending TEXT unsuccessfully

Unit A sends an MPAK TEXT to a subscriber B in the MOBITEX network. APP_DIR discovers some kind of error.



signal	signal_type	origin	from	signal_status
1	masc frame M			
2	S_MPAK	MASCn	MASCn	signal_status_ok
3	S_returned-I_incorrect_MPAK	MASCn	APP_DIR	signal_status_ok
4	masc frame R			

Observe that signal 3 has signal status set to signal_status_ok. Only line handlers and RADIO_NET may set signal_status to signal_status_not_sent.

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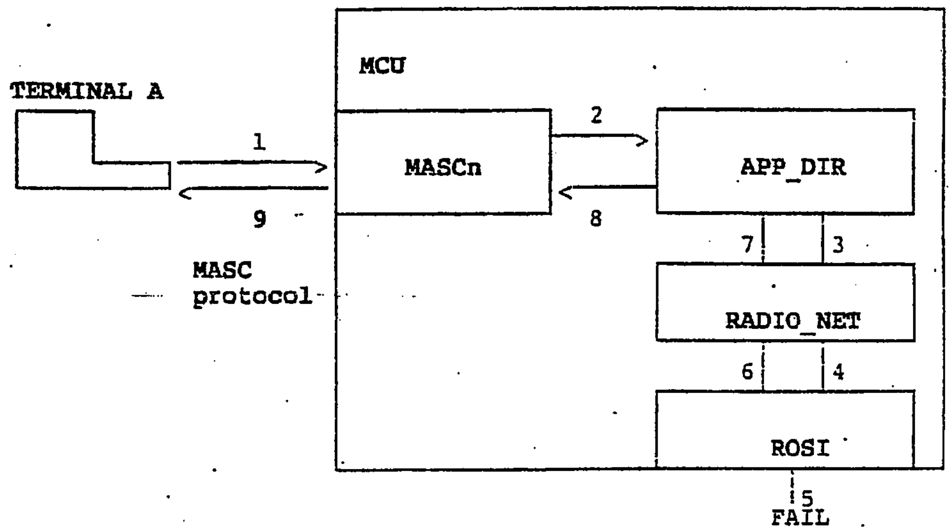
4.3 EXAMPLE 3: sending TEXT unsuccessfully

Unit A sends an MPAK TEXT to a subscriber B in the MOBITEX network. Transmission via radio fails.



signal	signal_type	origin	from	signal_status
1	masc frame M			
2	S_MPAK	MASCn	MASCn	signal_status_ok
3	S_MPAK	MASCn	APP_DIR	signal_status_ok
4 - 6 are not handled in this document.				
7	S_MPAK	MASCn	RADIO_NET	signal_status-_not_sent
8	S_not_sent_MPAK	MASCn	APP_DIR	signal_status_ok
9	masc frame N			

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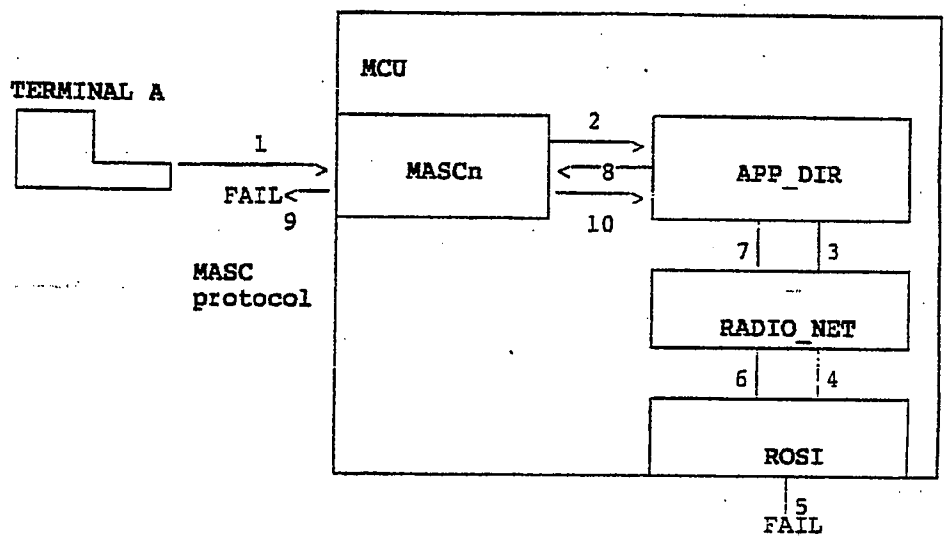
4.4 EXAMPLE 4: sending TEXT unsuccessfully.

Unit A sends an MPAK TEXT to a subscriber B in the MOBITEX network. Transmission via radio fails. The MCU fails to return the packet to unit A.



signal	signal_type	origin	from	signal_status
1	masc frame M			
2	S_MPAK	MASCn	MASCn	signal_status_ok
3	S_MPAK	MASCn	APP_DIR	signal_status_ok
4 - 6 are not handled in this document.				
7	S_MPAK	MASCn	RADIO_NET	signal_status-_not_sent
8	S_not_sent_MPAK	MASCn	APP_DIR	signal_status_ok
9	masc frame N			
10	S_not_sent_MPAK	MASCn	MASCn	signal_status-_not_sent

This sequence is the same as the one in example 3, except for signal 10. When receiving signal 10, APP_DIR discovers that origin = from, i.e. the signal is returned even from the MASC handler. The only thing APP_DIR can do is to forget the signal.

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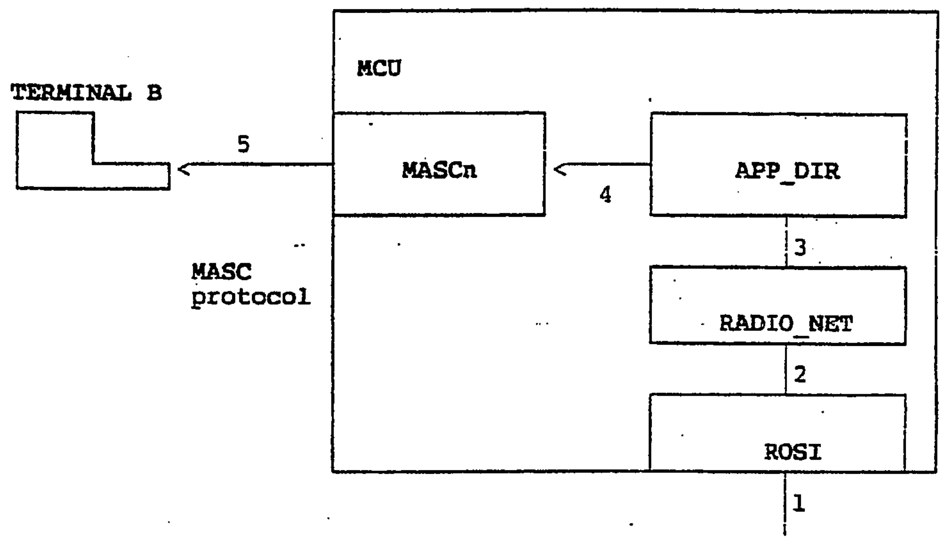
4.5 EXAMPLE 5: receiving TEXT successfully

MCU receives an MPAK TEXT, addressed to MCU-MAN.



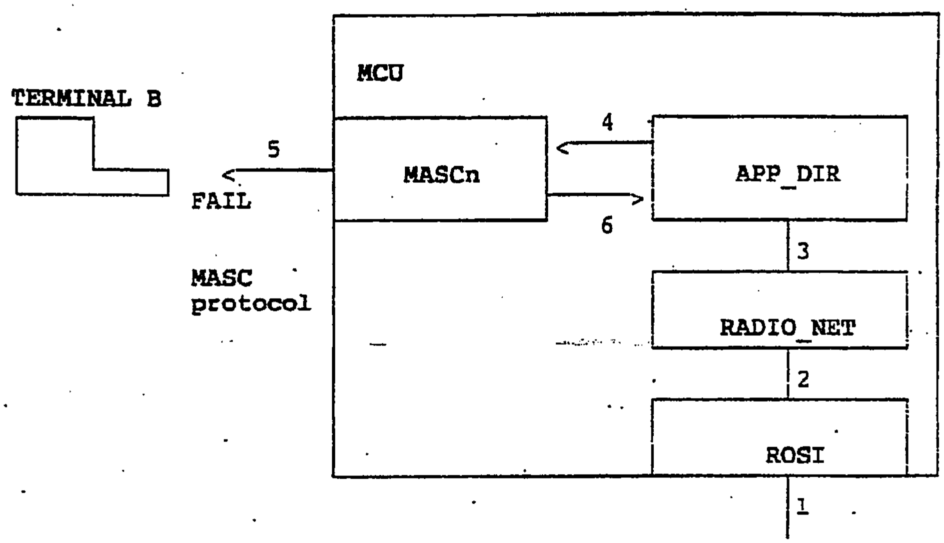
signal	signal_type	origin	from	signal_status
1 - 2 are not handled in this document.				
3	S_MPAK	RADIO_NET	RADIO_NET	signal_status_ok
4	S_MPAK	RADIO_NET	APP_DIR	signal_status_ok
5	masc frame M			

The sequence above is valid if there is only one line handler.

If an MPAK is addressed to the MCU_MAN, and there is more than one line handler, APP_DIR will send a copy of signal 4 to each one of them. But if the MPAK is addressed to a transferred MAN, APP_DIR will know on which of the line handlers this MAN can be reached.

4.6 EXAMPLE 6: receiving TEXT unsuccessfully

MCU receives an MPAK TEXT to unit B. Transmission to unit B fails. There is only one recevier in this example and MPAK is addressed to MCU_MAN.

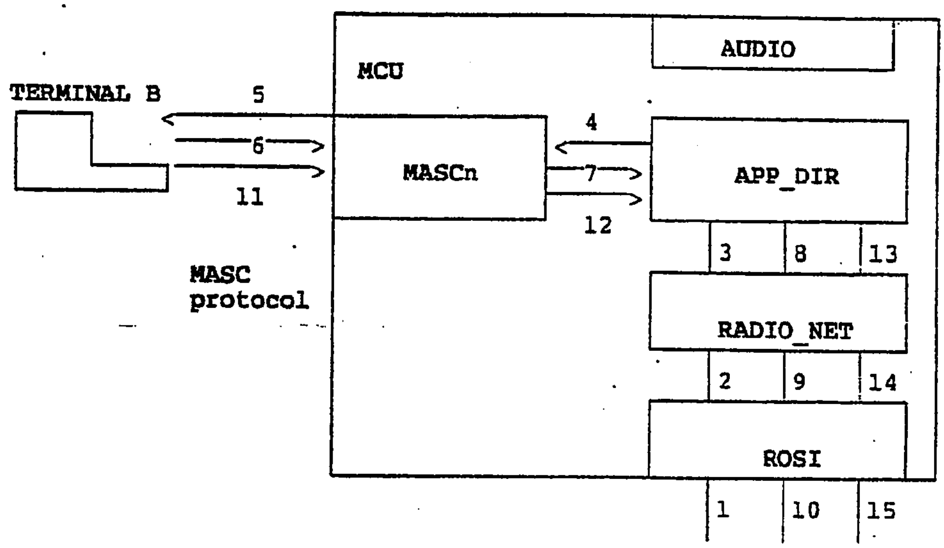


signal	signal_type	origin	from	signal_status
1 - 2 are not handled in this document.				
3	S_MPAK	RADIO_NET	RADIO_NET	signal_status_ok
4	S_MPAK	RADIO_NET	APP_DIR	signal_status_ok
5	masc frame M			
6	S_MPAK	RADIO_NET	MASCn	signal_status-_not_sent

Observe that an MPAK, addressed to MCU_MAN or any MAN included in the grouplist, must not under any circumstances, be returned to the MOBITEX network. In this application, APP_DIR forgets the MPAK.

4.7 EXAMPLE 7: receiving CONREQ

MCU receives an MPAK CONREQ addressed to unit B. Unit B responds with an MPAK CONREA after which the call can begin. Unit B terminates the call by sending an MPAK DISCON.



signal	signal_type	origin	from	signal_status
1 - 2 are not handled in this document.				
3	S_MPAK	RADIO_NET	RADIO_NET	signal_status_ok
4	S_MPAK	RADIO_NET	APP_DIR	signal_status_ok
5	masc frame M			
6	masc frame M			
7	S_MPAK	MASCn	MASCn	signal_status_ok
8	S_hook_off	MASCn	APP_DIR	signal_status_ok
9 - 10 are not handled in this document.				
11	masc frame M			
12	S_MPAK	MASCn	MASCn	signal_status_ok
13	S_hook_on	MASCn	APP_DIR	signal_status_ok
14 - 15 are not handled in this document				

Note: signal 1 - 5 contains MPAK CONREQ.
signal 6 - 7, 9-10 contains MPAK CONREA
signal 11 - 12, 14-15 contains MPAK DISCON

In this application S_hook_on and S_hook_off are always sent, instead of MPAK DISCON and MPAK CONREA, to the RADIO_NET.

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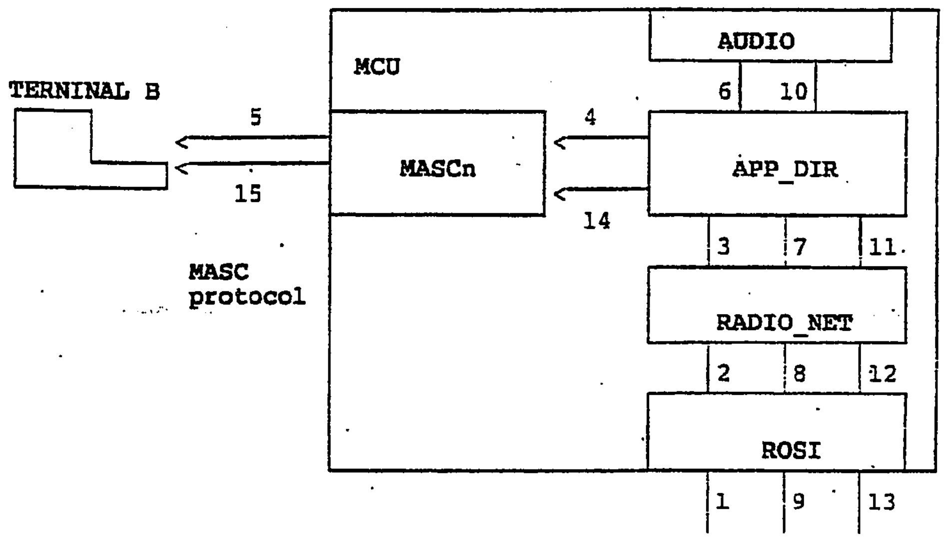
4.8 EXAMPLE 8: receiving CONREQ

MCU receives an MPAK CONREQ addressed to unit B. The audio interface generates a hook off after which the call can begin. The call is terminated by the audio interface generating an hook on.



signal	signal_type	origin	from	signal_status
1 - 2 are not handled in this document.				
3	S_MPAK	RADIO_NET	RADIO_NET	signal_status_ok
4	S_MPAK	RADIO_NET	APP_DIR	signal_status_ok
5	masc frame M			
6	S_hook_off	AUDIO	AUDIO	signal_status_ok
7	S_hook_off	AUDIO	APP_DIR	signal_status_ok
8 - 9 are not handled in this document.				
10	S_hook_on	AUDIO	AUDIO	signal_status_ok
11	S_hook_on	AUDIO	APP_DIR	signal_status_ok
12 - 13 are not handled in this document				
14	S_MPAK	RADIO_NET	APP_DIR	signal_status_ok
15	masc frame M			

Note: signal 1 - 5 contains MPAK CONREQ
signal 8 - 9 contains MPAK CONREA
signal 12 - 15 contains MPAK DISCON

Observe that APP_DIR generates MPAK DISCON to unit B . This is to avoid blocking situations in unit B.

5 LISTS OF SIGNALS

Signals that are sent within the MCU, interfaces A, B and C in figure 1, are listed below. The signals are divided into categories of normal and returned signals.

5.1 Interface A

5.1.1 Signals sent from APP_DIR to line handlers

Normal signals

S_MPAK

origin	=	creator of this signal
from	=	APP_DIR
signal_status	=	signal_status_ok
signal_type	=	S_MPAK
MPAK	=	MPAK in question

S_not_sent_MPAK

origin	=	creator of original MPAK
from	=	APP_DIR
signal_status	=	signal_status_ok
signal_type	=	S_not_sent_MPAK
MPAK	=	MPAK in question

S_returned_incorrect_MPAK

origin	=	creator of original MPAK
from	=	APP_DIR
signal_status	=	signal_status_ok
signal_type	=	S_returned_incorrect_MPAK
MPAK	=	MPAK in question

S_MPAK_sent_on_radio

origin	=	creator of original MPAK
from	=	APP_DIR
signal_status	=	signal_status_ok
signal_type	=	S_MPAK_sent_on_radio

5.1.2 Signals sent from line handlers to APP_DIR

Normal signals

S_line_up

origin	=	line handler in question
from	=	origin
signal_status	=	signal_status_ok
signal_type	=	S_line_up

S_line_down

origin	=	line handler in question
from	=	origin
signal_status	=	signal_status_ok
signal_type	=	S_line_down

S_MPAK

origin	=	line handler in question
from	=	origin
signal_status	=	signal_status_ok
signal_type	=	S_MPAK
MPAK	=	MPAK in question

Returned signals

S_MPAK

origin	=	no change in this field
from	=	line handler in question
signal_status	=	signal_status_not_sent
signal_type	=	S_MPAK
MPAK	=	MPAK in question

S_MPAK_sent_on_radio

origin	=	no change in this field
from	=	line handler in question
signal_status	=	signal_status_not_sent
signal_type	=	S_MPAK_sent_on_radio

S_returned_incorrect_MPAK

origin	=	no change in this field
from	=	line handler in question
signal_status	=	signal_status_not_sent
signal_type	=	S_returned_incorrect_MPAK
MPAK	=	MPAK in question

S_not_sent_MPAK

origin	=	no change in this field
from	=	line handler in question
signal_status	=	signal_status_not_sent
signal_type	=	S_not_sent_MPAK
MPAK	=	MPAK in question

5.1.3 Signals from APP_DIR to AUDIO

All signals listed in 5.1.1.

5.1.4 Signals from AUDIO to APP_DIR

All signals listed in 5.1.2, plus the following:

S_hook_off

origin	=	AUDIO
from	=	AUDIO
signal_status	=	signal_status_ok
signal_type	=	S_hook_off

S_hook_on

origin	=	AUDIO
from	=	AUDIO
signal_status	=	signal_status_ok
signal_type	=	S_hook_on

5.1.5 Signals from APP_DIR to RADIO_NET

Normal signals

S_MPAK

origin	=	creator of this signal
from	=	APP_DIR
signal_status	=	signal_status_ok
signal_type	=	S_MPAK
MPAK	=	MPAK in question

S_hook_on

origin	=	AUDIO
from	=	APP_DIR
signal_status	=	signal_status_ok
signal_type	=	S_hook_on

S_hook_off

origin	=	AUDIO
from	=	APP_DIR
signal_status	=	signal_status_ok
signal_type	=	S_hook_off

5.1.6 Signals from RADIO_NET to APP_DIR

Normal signals

S_MPAK

origin	=	RADIO_NET
from	=	origin
signal_status	=	signal_status_ok
signal_type	=	S_MPAK
MPAK	=	MPAK in question

Returned signals

S_MPAK

origin	=	no change in this field
from	=	RADIO_NET
signal_status	=	signal_status_not_sent
signal_type	=	S_MPAK
MPAK	=	MPAK in question

S_hook_on

origin	=	AUDIO
from	=	RADIO_NET
signal_status	=	signal_status_not_sent
signal_type	=	S_hook_on

S_hook_off

origin	=	AUDIO
from	=	RADIO_NET
signal_status	=	signal_status_not_sent
signal_type	=	S_hook_off

6 REGISTERS IN APP_DIR

Four registers are kept in APP_DIR:

6.1 Register number one: MCU_REG

The register called MCU_REG has the structure shown in the figure below.

LINE		MASC1 MASC2 MASC3 AUDIO PRINTER
MAY / MAY NOT INACTIVATE MCU		
LINE_UP / LINE_DOWN		
MSG TYPE	TEXT	
	STATUS	
	DATA	
	HPDATA	
	SPEECH	
	EMERGENCY	
	EXTPAK	

line
: Contains the line handlers that exist in this application. This is static information.

msg type
: Tells which MPAKs, addressed to MCU_MAN or any MAN in the grouplist, will be received by the line handler. As an example, there is nothing to prevent that MPAK TEXT is received by a number of line handlers. In the speech connection case, in this particular application, only one line handler can be enabled. Msg type contains static information.

may/may not inactivate MCU
: Tells whether the line handler in question is allowed to inactivate MCU with an MPAK DTESERV.INACTIVE. Normally, only one (or very few) of the line handlers should be allowed to do this. This is static information.

line up/down
Contains information about each of the connected line handlers. This information is dynamic.

The figure below shows how the MCU_REG may be used.

LINE		MASC1	MASC2	MASC3	AUDIO	PRINTER
MAY / MAY NOT INACTIVATE MCU		MAY	NOT	NOT	NOT	NOT
LINE_UP / LINE_DOWN		UP	UP	DOWN	UP	UP
MSG TYPE	TEXT	X	X	X		X
	STATUS				X	
	DATA	X				
	HPDATA	X				
	SPEECH	X				
	EMERGENCY	X				
	EXTPAK	X				

In this case, only MASC1 is allowed to inactivate the MCU. All line handlers, except for MASC3, are connected and intact. When APP_DIR receives an MPAK TEXT from MOBITEX network, it will be sent to MASC1, MASC2 and PRINTER. Since MASC3 does not have status line_up, it does not receive any MPAKs. Received MPAK STATUS is to be sent to AUDIO. Other MPAKs are to be sent to MASC1.

Observe that APP_DIR does not keep information of if MCU is active or inactive. Nor does APP_DIR know if RADIO_NET has received an MPAK DIE from the MOBITEX network. It is the responsibility of RADIO_NET to keep information about this. If RADIO_NET notes which APP_DIR is not allowed to send to the MOBITEX network, the packets are returned to APP_DIR with signal status set to signal_status_not_sent.

6.2 Register number two: FLEXLIST

The FLEXLIST register has the structure shown in the figure below.

MAN	LINE	STATUS
.		
.		
.		

MAN - The MOBITEX subscription number of the transferred subscriber. Up to seven MAN-numbers are allowed.

LINE - The line handler to which the transferable has transferred.

STATUS - Tells login status.
It can be: UNDER_LOGIN - the login sequence is not yet finished
OK_LOGIN - the login sequence is finished and accepted

6.3 Register number three: GROUPLIST

The GROUPLIST contains a list of group MAN numbers. Up to 15 MAN numbers is allowed.

6.4 Register number four: CONNECTION_REG

CONNECTION_REG keeps information about the status of the speech line. It contains the following information:

CONNECTION_STATUS - can be free, busy or waiting_for_hook_off

CONNECTION_PARTY_HERE - MAN number for connection part in the MCU

CONNECTION_OTHER_PARTY - MAN number for the other connection part

CONNECTION_CONN_ID - connection identity for current speech line connection

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7 REQUIREMENTS ON THE NETWORK LAYER IN MCU

Requirements on the network layer in MCU (RADIO_NET) are listed below:

1. Everything applicable to mobile terminal in document MOBITEX network layer for terminals, 5/1056 - A 296 5171.

2 All MPAKs that the application wants to send via radio and network layer to
- be acknowledged to the application if the transmission was successful,
- be returned to the application if the transmission failed.

3 The signals hook_on and hook_off will be returned to the application if the transmission via radio fails.

4 The following MPAKs, received by the MCU via radio, to be sent to the application:
- all MPAKs of class PSUBCOM
- all MPAKs of class PSOSCOM.
  Note that a transferred subscriber, connected to the MCU via an MASC handler, can be emergency receiver.
- following MPAKs, belonging to the class CSUBSOM:
  + CONREQ
  + ADDCONREQ
  + SOSCONREQ
  + EXTCONREQ
  + CONORD
  + DISCON

- following MPAKs, belonging to the class DTESERV:
  + LOGINREQ * **
  + LOGINREF **
  + LOGOUTORD **
  + LOGINGRA **
  + FLEXLIST **
  + TIME
  + GROUPLIST **
  + SOSRX * ***
  + VICESOSRX * ***

* These MPAKs can only have MPAK states that are not OK.

** These MPAKs concern flexlist and grouplist. They are handled by the network layer and sent to the application. The reason for this is that the application has copies of flexlist and grouplist.

*** Only if a terminal, connected to the MCU, has an emergency receiver transferred to it.

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8 REQUIREMENTS ON A FIXED TERMINAL

The requirements for a fixed terminal which is able to connect to the MOBITEX network as well as the MCU are as follows.

Link layer

Frames in the masc protocol for implemented:

All control frames :
ACK, RACK, NACK, SENS, SACK

Following information frames:
B, M, E, R, F_P, F_Q, N

Network layer

The MOBITEX network considers a fixed terminal, connected via an MCU, as a mobile terminal. This has the following consequencies as to which MPAKs may be sent and received by the terminal:.

class PSUBCOM:
The terminal is allowed to send and receive all MPAKs in this class.

class PSOSCOM:
An emergency sender can be a mobile subscriber or a transferable subscriber which is transferred to a mobile subscriber. A receiver can be a fixed terminal subscriber or a transferable subscriber.
All emergency senders can send SOS and receive SOSACK. Furthermore, all mobile terminals are be able to receive SOS and SOSACK addressed to All terminals group MAN.

class CSUBCOM:
If the fixed terminal has one line for speech line connection, the following MPAKs can be received and sent:
CONREQ
SOSCONREQ
ADDCONREQ
EXTCONREQ
CONREA
DISCON

Connection to group will be made by the MCU by converting CONORD to CONREQ.

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class DTESERV:
Following MPAKs may be sent:
- LOGINREQ
- LOGOUT
- ACTIVE
- INACTIVE
- VICESOSRX
- SOSRX *
- FLEXLIST *

* Only if the sender is a transferable subscriber.

Following MPAKs shall be received:
- LOGINREQ
- LOGINGRA
- LOGINREF
- LOGOUTORD
- VICESOSRX
- SOSRX
- GROUPLIST
- FLEXREQ
- TIME

When the network layer receives masc frame N from the masc interface, it acts in the same manner as if the MPAK never leaved the fixed terminal.

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9 PSEUDO CODE FOR APP_DIR

In this pseudo code all procedures start with "P_", and all functions with "F_".

```
REPEAT
  Wait for input
  CASE input signal_type OF
  S_MPAK_sent_on_radio
    IF from = RADIO_NET THEN
       send this signal to origin
    ELSE
       forget this signal
    END IF
  S_hook_on
    P_hook_on
  S_hook_off
    P_hook_off
  S_line_up
    P_line_up
  S_line_down
    P_line_down
  S_MPAK
    P_MPAK
  conord_timer
    CONNECTION_STATUS = free
  otherwise
    forget this signal
  END CASE input signal OF
UNTIL forever
```

```
P_hook_on
  IF ( from = AUDIO ) AND ( CONNECTION_STATUS <> free )
  THEN
    send this signal to RADIO_NET
    send signal S_MPAK with MPAK = DISCON to
    CONNECTION_LINE
      (MPAK.sender = CONNECTION_OTHER_PARTY
       MPAK.addressee = CONNECTION_PARTY_HERE
       MPAK.type_dependent.line number = 0
       MPAK.type_dependent.CONN_ID=CONNECTION_CONN_ID)
    CONNECTION_STATUS = free
  ELSE
    forget this signal
  END IF (from = AUDIO) AND (CONNECTION_STATUS <>free)...
END P_hook_on
```

```
P_hook_off
  IF from = AUDIO THEN
    IF CONNECTION_STATUS = waiting_for_hook_off THEN
      CONNECTION_STATUS = busy
      send this signal to RADIO_NET
      reset conord_timer
    ELSE
      forget this signal
    END IF CONNECTION_STATUS = waiting_for_hook_off...
  ELSE
    IF (from=RADIO_NET) AND (signal_status =
                            signal_status_not_sent) THEN
      forget this signal
      send signal S_MPAK with MPAK = DISCON to
      CONNECTION_LINE
      ( MPAK.sender = CONNECTION_OTHER_PARTY
        MPAK.addressee = CONNECTION_PARTY_HERE
        MPAK.type_dependent.line number = 0
        MPAK.type_dependent.CONN_ID = CONNECTION_CONN_ID   )
      CONNECTION_STATUS = free
    ELSE
      forget this signal
    END IF (from = RADIO_NET) AND (signal_status =...)
  END IF from = AUDIO...
END P_hook_off


P_line_down
  mark origin in MCU_REG as line_down
  FOR all MAN in our flexlist pointing at origin DO
      send signal S_MPAK with MPAK = logout to RADIO_NET
        ( MPAK.sender = MAN in question from flexlist
          MPAK.addressee = the MOBITEX network
          MPAK.type_dependent_part = MCU_MAN )
      remove MAN in question from our flexlist
  END FOR all MAN in our flexlist pointing...
END P_line_down


P_line_up
  send signal S_MPAK with MPAK = grouplist to origin
     ( MPAK.sender = the MOBITEX network
       MPAK.addressee = MCU_MAN
       MPAK.type_dependent_part = our grouplist )
  send signal S_MPAK with MPAK = flexreq to origin
     ( MPAK.sender = the MOBITEX network
       MPAK.addressee = MCU_MAN )
  mark origin in MCU_REG as line_up
END P_line_up
```

```
P_MPAK
  IF signal_status = signal_status_ok THEN
    IF from = RADIO_NET THEN
      P_MPAK_from_radio
    ELSE
      P_MPAK_from_other
    END IF from = RADIO_NET...
  ELSE
    IF origin = from THEN
      forget this signal  (can't send this signal in any
                           direction )
    ELSE
      IF origin = RADIO_NET THEN
        forget this signal (Never send back MPAK to
                            network)
      ELSE
        IF MPAK.unknown_f = 0 THEN
          CASE MPAK.packet_class OF
          PSUBCOM,PSOSCOM
            signal_status = signal_status_ok
            signal_type = S_not_sent_MPAK
            send this signal to origin
          CSUBCOM
            CASE MPAK.packet_type OF
            CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ
              signal_status = signal_status_ok
              signal_type = S_not_sent_MPAK
              send this signal to origin
              CONNECTION_STATUS = free
            otherwise
              forget this signal
            END CASE MPAK.packet_type...
          DTESERV
            CASE MPAK.packet_type OF
              VICESOSRX,SOSRX
                signal_status = signal_status_ok
                signal_type = S_not_sent_MPAK
                send this signal to origin
              LOGINREQ
                remove MPAK.type_dependent_part from our
                flexlist
                signal_status = signal_status_ok
                signal_type = S_not_sent_MPAK
                send this signal to origin
              otherwise
                forget this signal
            END CASE MPAK.packet_type...
          END CASE MPAK.class...
        ELSE
          forget this signal
        END IF MPAK.unknown_f.
      END IF origin...
    END IF origin...
  END IF signal_status...
END P_MPAK
```

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```
P_MPAK_from_other
  mark origin in MCU_REG as line_up
  CASE MPAK.packet_class OF
  PSUBCOM,PSOSCOM
    IF MPAK.unknown_f = 1 THEN
      IF (F_get_receiver_MAN in our grouplist ) OR
      (F_get_receiver_MAN = MCU_MAN ) THEN
        forget this signal
      ELSE
        IF F_get_receiver_MAN in our flexlist THEN
          remove F_get_receiver_MAN from our flexlist
          send signal S_MPAK with MPAK = LOGOUT to RADIO_NET
                  ( MPAK.sender = F_get_receiver_MAN
                    MPAK.addressee = the MOBITEX network
                    MPAK.type_dependent_part = MCU_MAN ) .
        END IF F_get_receiver_MAN in our flexlist
        send this signal to RADIO_NET
      END IF (F_get_receiver_MAN in our grouplist...
    ELSE ( IF MPAK.unknown_f = 1 ...)
      IF (MPAK.state <> OK ) OR ( MPAK.digital_f =1 ) THEN
        signal_type = S_returned_incorrect_MPAK
        send this signal to origin
      ELSE
        IF (F_get_transmitting_MAN = MCU_MAN ) or
        (F_get_transmitting_man in our flexlist with status
         ok_login ) THEN
          send this signal to RADIO_NET
        ELSE
          send signal S_MPAK with MPAK = LOGOUTORD to origin
          (MPAK.sender = the MOBITEX network
           MPAK.addressee = MCU_MAN
           MPAK.type_dependent_part= F_get_transmitting_MAN)
           signal_type = S_not_sent_MPAK
           signal_status = signal_status_ok
           send this signal to origin
        END IF (F_get_transmitting_MAN = MCU_MAN...
      END IF MPAK.state...
    END IF MPAK.unknown_f...
  CSUBCOM
    CASE MPAK.packet_type OF
    CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ
      IF ( MPAK.unknown_f = 0 ) and
      ( MPAK.mailbox_f = 0 ) and
      ( MPAK.sendlist_f = 0 ) and
      ( mpak.state = OK ) THEN
        IF (F_get_transmitting_MAN = MCU_MAN ) or
        (F_get_transmitting_MAN is in our flexlist with
        status ok_login )
          THEN
            IF CONNECTION_STATUS = free THEN
              CONNECTION_line = origin
              CONNECTION_status = busy
              send this signal to RADIO_NET
```

```
            ELSE
              signal_type = S_not_sent_MPAK
              signal_status = signal_status_ok
              send this signal to origin
            END IF CONNECTION_STATUS = free...
          ELSE
            send signal S_MPAK with MPAK = LOGOUTORD  to
            origin
             ( MPAK.sender = the MOBITEX network
               MPAK.addressee = MCU_MAN
               MPAK.type_dependent_part =
               F_get_transmitting_MAN )
             signal_type = S_not_sent_MPAK
             signal_status = signal_status_ok
             send this signal to origin
        END IF (F_get_transmitting_MAN = MCU_MAN...
      ELSE
        signal_type = S_returned_incorrect_MPAK
        send this signal to origin
      END IF ( MPAK.unknown_f = 0...
    CONREA
      IF ( CONNECTION_STATUS = waiting_for_hook_off) and
      ( origin = CONNECTION_line ) THEN
        forget this signal
        send signal S_hook_off to RADIO_NET
        CONNECTION_STATUS = busy
        reset conord_timer
      ELSE
        forget this signal
    DISCON
      IF ( CONNECTION_STATUS <> free) and
      ( origin = CONNECTION.line ) THEN
        forget this signal
        send signal hook_on to RADIO_NET
        CONNECTION_STATUS = free
      ELSE
        forget this signal
    otherwise
      forget this signal
    END CASE MPAK.packet_type...
  DTESERV
    CASE MPAK.packet_type OF
    LOGINREQ,LOGOUT,ACTIVE,INACTIVE,VICESOSRX,SOSRX,FLEXLIST
      IF (MPAK.state = ok ) AND
      ( MPAK.digital_f = 0 ) AND
      ( MPAK.mailbox_f = 0 ) AND
      ( MPAK.sendlist_f = 0 ) AND
      ( MPAK.unknown_f = 0 ) AND
      ( MPAK.extern_f = 0 ) AND
      ( MPAK.addressee = MOBITEX network ) THEN
        CASE MPAK.packet_type OF
        LOGINREQ,ACTIVE,INACTIVE,FLEXLIST
          IF MPAK.sender = MCU_MAN THEN
            CASE MPAK.packet_type OF
```

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```
LOGINREQ
  IF MPAK.type_dependent_part in our flexlist
  with status = ok_login THEN
    send signal S_MPAK with MPAK LOGINGRA to
    origin
      ( MPAK.sender = the MOBITEX network
        MPAK.addressee = MCU_MAN
        MPAK.type_dependent_part =
         =<old>MPAK.type_dependent_part )
    forget this signal
  ELSE
    IF more space exists in our flexlist THEN
      mark MPAK.type_dependent_part in our
      flexlist
      with status=under_login and line =
      origin
      send this signal to RADIO_NET
    ELSE
      signal_type = S_not_sent_MPAK
      signal_status = signal_status_ok
      send this signal to origin
    END IF more space in our flexlist...
  END IF MPAK.type_dependent_part in our...
ACTIVE,INACTIVE
  IF origin may inactivate THEN
    P_line_down
    send this signal to RADIO_NET
  ELSE
    P_line_down
    forget this signal
  END IF origin may activate/inactivate...
FLEXLIST
  FOR all MAN in MPAK.FLEXLIST not in our
  flexlist
    with status ok_login DO
      send signal S_MPAK with MPAK = logoutord
      to origin
        ( MPAK.sender = the MOBITEX network
          MPAK.addressee = MCU_MAN
          MPAK.type_dependent_part = MAN in
                                     question )
  END FOR all MAN in MPAK.FLEXLIST not in our...
  forget this signal
END CASE MPAK.packet_type
ELSE  ( IF MPAK.sender = MCU_MAN)
  signal_type = S_returned_incorrect_MPAK
  send this signal to origin
END IF MPAK.sender = MCU_MAN...
```

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```
                VICESOSRX,SOSRX
                  IF MPAK.sender in our flexlist with status
                  ok_login THEN
                    send this signal to RADIO_NET
                  ELSE
                    signal_type = S_not_sent_MPAK
                    signal_status = signal_status_ok
                    send this signal to origin from
                  END IF MPAK.sender in our flexlist with status...
                LOGOUT
                  IF MPAK.sender in our flexlist with any status
                  THEN
                    delete MPAK.sender from our flexlist
                    MPAK.type_dependent_part = MCU_MAN
                    send this signal to RADIO_NET
                  ELSE
                    forget this signal
                  END IF MPAK.sender in our flexlist ...
                END CASE MPAK.packet_type...
              ELSE
                signal_type = S_returned_incorrect_MPAK
                send this signal to origin
              END IF (MPAK.state = ok...
            otherwise
              signal_type = S_returned_incorrect_MPAK
              send this signal to origin
            END CASE MPAK.packet_type...
          END CASE MPAK.class...
        END P_MPAK_from_other


        P_MPAK_from_radio
          CASE MPAK.class OF
          PSUBCOM,PSOSCOM
            IF F_get_receiver_MAN in our flexlist THEN
              send this signal to line in question
            ELSE
              IF ( F_get_receiver_MAN = MCU_MAN ) OR
              ( F_get_receiver_MAN in our grouplist ) THEN
                CASE MPAK.class OF
                PSUBCOM
                  CASE MPAK.packet_type OF
                  TEXT
                    P_copy_and_send_signal( text )
                  STATUS
                    P_copy_and_send_signal( status )
                  HPDATA
                    P_copy_and_send_signal( hpdata )
                  DATA
                    P_copy_and_send_signal( data )
                  EXTPAK
                    P_copy_and_send_signal (EXTPAK)
                  otherwise
                    forget this signal
                  END CASE MPAK.packet_type...
```

```
                PSOSCOM
                  IF ( MPAK.packet_type = SOS or SOSINFO )
                  AND ( MPAk.addressee = all terminal group MAN )
                  THEN
                    IF MPAK.sender in out flexlist THEN
                      send this signal to line in question
                    ELSE
                      P_copy_and_send_signal( emergency )
                    END IF MPAK.sender in our flexlist...
                  ELSE
                    P_copy_and_send_signal( emergency )
                  END IF ( MPAK.packet_type =. SOS or SOSINFO..
                END CASE MPAK.class...
              ELSE
                ( This case can not appear; the network layer shall
                  take care of unknown MPAKs from the network)
                MPAK.unknown_f = 1
                send this signal to RADIO_NET
              END IF ( F_get_receiver_MAN = MCU_MAN...
            END IF F_get_receiver_MAN in our flexlist...
          CSUBCOM
            CASE MPAK.packet_type OF
              CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ
                IF MPAK.state <> ok THEN
                  P_discon
                ELSE
                  IF F_get_receiver_MAN in our flexlist THEN
                    CONNECTION_STATUS  = waiting_for_hook_off
                    CONNECTION_LINE = line in question from flexlist
                    CONNECTION_PARTY_HERE = MPAK.addressee
                    CONNECTION_OTHER_PARTY  = MPAK.sender
                    CONNECTION_CONN_ID  =MPAK.type_dependent.conn_id
                    send this signal to line in question
                  ELSE
                IF F_get_receiver_MAN = MCU_MAN THEN
                    CONNECTION_STATUS  = waiting_for_hook_off
                    CONNECTION_PARTY_HERE = MPAK.addressee
                    CONNECTION_OTHER_PARTY  = MPAK.sender
                    CONNECTION_CONN_ID  =MPAK.type_dependent.conn_id
                    send this signal to first line in MCU_REG with
                    (line_status = up) AND (msg_type = speech)
                    IF no such line THEN
                      forget this signal
                      CONNECTION_STATUS = waiting_for_hook_off
                      send signal S_hook_on to RADIO_NET
                    ELSE
                      CONNECTION_LINE = line in question from
                      MCU_REG
                    END
                  ELSE
                    forget this signal
                    send signal S_hook_on to RADIO_NET
                  END IF ( F_get_receiver_MAN = MCU_MAN...
                END IF F_GET_receiver_MAN in our flexlist...
              END IF MPAK.state <> ok
```

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```
        CONORD
          IF CONNECTION_STATUS = free THEN
            IF F_get_receiver_MAN in our grouplist THEN
              MPAK.packet_type = CONREQ
              CONNECTION_STATUS  = waiting_for_hook_off
              CONNECTION_PARTY_HERE   = MPAK.addressee
              CONNECTION_OTHER_PARTY  = MPAK.sender
              CONNECTION_CONN_ID= MPAK.type_dependent.conn_id
              send this signal to first line in MCU_REG with
              ( line_status = up ) AND ( msg_type = speech )
              IF no such line THEN
                forget this signal
                CONNECTION_STATUS = free
                send signal S_hook_on to RADIO_NET
              ELSE
                CONNECTION_LINE = line in question from MCU_REG

                set timer: conord_timer
              END
            ELSE
              forget this signal
              send signal S_hook_on to RADIO_NET
            END IF F_get_receiver_MAN in our grouplist...
          ELSE
            forget this signal
          END IF CONNECTION_STATUS = free...
        DISCON
          P_discon
        otherwise
          forget this signal
        END CASE MPAK.packet_type...
      DTESERV
        CASE MPAK.packet_type OF
        LOGINREQ,LOGINREF,LOGOUTORD
          IF MPAK.type_dependent in our flexlist THEN
            send this signal to line IN QUESTION
            remove MAN in question from our flexlist
          ELSE
            forget this signal
          END IF MPAK.type_dependent in our flexlist THEN
        LOGINGRA
          IF MPAK.type_dependent in our flexlist THEN
            mark in our flexlist status = ok_login
            send this signal to line in question
          ELSE
            send signal S_MPAK with MPAK = logout to RADIO_NET
            ( MPAK.sender = MCU_MAN
            MPAK.addressee =  MOBITEX network
            MPAK.type_dependent_part = MAN in question
          END IF MPAK.type_dependent in our flexlist ....
```

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```
FLEXLIST
  FOR all MAN in this signal who are not in our flexlist
    send signal S_MPAK with MPAK = logout to RADIO_NET
          ( MPAK.sender = MCU_MAN
            MPAK.addressee = MOBITEX network
            MPAK.type_dependent_part = MAN in question)
  END
  FOR all MAN in our flexlist who are not in this signal
    send signal S_MPAK with MPAK = logoutord to line in
    question
       ( MPAK.sender = MOBITEX network
         MPAK.addressee =  MCU_MAN
         MPAK.type_dependent_part = MAN in question )
    remove MAN in question from our flexlist
  END
TIME
  send a copy of this signal to all lines
GROUPLIST .
  store grouplist from this signal in our register
  send a copy of this signal to all lines
SOSRX,VICESOSRX
  IF F_get_receiver_MAN in our flexlist THEN
    send this signal to line in question
  ELSE forget this signal
END CASE MPAK.packet_type OF...
END CASE MPAK.class...
END P_MPAK_from_radio



P_copy_and_send_signal( type )
  send a copy to all lines in MCU_REG with
  ( line_status = up ) and ( msg_type = type )
END P_copy_and_send_signal



P_discon
  IF CONNECTION_STATUS <> free
    send this signal to CONNECTION_LINE
    CONNECTION_STATUS = free
  ELSE
    forget this signal
  END
END P_discon
```

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```
F_get_receiver_MAN
  CASE MPAK.state OF
    ok,from_mail
      F_get_receiver_MAN = MPAK.sender
    otherwise
      F_get_receiver_MAN = MPAK.addressee
  END CASE
END F_get_receiver_MAN


F_get_transmitting_MAN
  IF MPAK.unknown_f = 0 THEN
    F_get_transmitting_MAN = MPAK.sender
  ELSE
    F_get_transmitting_MAN = F_get_receiver_MAN
  END
END F_get_transmitting_MAN
```

10 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-09, 3
R1-16, 3

Below are the reference designations listed.

Reference	Section
R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05	References
R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

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Uppgjord Prepared	Faktaansvarig Subject responsible	Nr No	
ET/SYS PES	ET/SYS PES	1056 - A 296 5177/02 Ue	
Dokansv/Godkänd Doc respons/approved		Datum Date / Rev	Fil File
ET/SYSC STT *STT*		1990-02-26 A	MTS20.2
Benämning		Titel	
Cantel Mobitex™		MOBITEX General requirements, mobile term.	

SUMMARY

The general requirements for MOBITEX mobile terminals are described in this document. These include environmental requirements, power supply requirements, the minimum requirements for controls and indicators and special requirements in connection with the type approval testing.

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1 ENVIRONMENTAL REQUIREMENTS

The equipment must be operational also under the extreme temperature conditions. No error functions which can interfere with the operation of the MOBITEX network must occur under any environmental condition.

1.1 Temperature

The normal operational temperature range:

+15 to +35 degrees C.

The extreme operational temperature range:

-25 to +55 degrees C.

The equipment should be such that it is not damaged by storage in the temperature range of:

-40 to +70 degrees C.

1.2 Relative humidity

Mobil terminal should be able to withstand 20-75% RH.

1.3 Vibrations

The equipment should be able to withstand a vibration test in accordance with IEC publication 68-2-6:

10 - 55 Hz +/- 0,15 mm movement.

55 - 150 Hz 20 m/s square acceleration.

Sweep rate: 1 octave per minute

Duration: 2 hours in each of the three directions.

The equipment should not be in operation during the test but should comply with the requirements in the MOBITEX terminal specification after the test.

2 POWER SUPPLY

2.1 Nominal voltage

The nominal voltage is optional and should be stated by the manufacturer.

2.2 Voltage limits

Equipment designed for working from lead acid accumulators in a vehicle should comply with the specifications when the voltage varies from 0.9 to 1.3 times the nominal voltage.

Equipment designed for operating on an alternating voltage should comply with the specifications when the voltage varies by +10%.

If these limiting values are exceeded, error functions which can interfere with the operation of the network should not occur.

3 MARKING

The equipment should be clearly marked with the manufacturer, type designation, serial number, approving text ("Approved by ... ") and registration number of the type approval. The marking should be engraved on metal and permanently fixed to the equipment.

The mobile terminal's subscription number should be clearly visible or accessible.

3.1 Electronic serial number check

The serial number should be stored together with the terminal subscription MAN and permanently in such a way that they are impossible to change by software or by unauthorised persons, preferably in enchrypted form.

The serial number of the equipment should be checked in the terminal against the serial number stored together with the MAN at power on. If the numbers are not equal, it should be impossible to use the equipment.

In addition, the serial number (ESN) is sent to the network at "activation", to be checked with the serial number stored in the network (see reference R1-09).

4 CONTROLS

There are no requirements for type approval of controls. There are certain recommendations however.

If number keys for number keying are used, they should comply with one of the following minimum configurations.

```
1 2 3 4 5 * A B
6 7 8 9 0 # C D


1 2            1 2 3 A
3 4            4 5 6 B
5 6            7 8 9 C
7 8            * 0 # D
9 0
* #
A B
C D
```

The following recommendations apply for the A, B, C and D keys. The D key should have the data send function. If there is a speech facility, key C is used for "speech request". The key should be marked with T. Keys A and B can be used for status or another function and marked according to use.

International standards should be followed if a completely alphanumeric keyboard is used. The number keys on the keyboard can then be used for number keying as well.

5 INDICATORS

An indicator with yellow or amber colour should indicate when the power is switched on.

An indicator with green colour should indicate with a steady light when the mobile terminal is in contact with the MOBITEX network and with a twinkling light when it is not (base search mode).

6 TYPE APPROVAL TESTING

Except the equipment described in the chapters below, requirements may be specified by the network operator (please refer to reference R1-06) for equipment such as:

- Portable antennas
- Cabling and terminations
- Terminal display

6.1 Equipment to be type approved

The type approval test applies to the radio equipment and to the physical, link and network layers of the mobile equipment according to these specifications. Application layer functions are only tested if under special requirements when installed.

The type approval only applies to the software tested. If a change is made in any software stored in the same storage unit as the software handling the tested functions, a new type test must be made. The testing authority should determine at its discretion and based on documentation of the modifications, wether new measurements are necessary for a new approval.

Optional terminal equipment to be connected to the radio control unit is not type tested.

6.2 Normal test conditions

The mobile terminal should be tested in the normal environment stated above. The specified data should be complied with for all combinations.

Terminals designed for operating on lead acid accumlators in vehicles should be tested at 1.0 times the nominal voltage.

The terminal should be ready for operation within 1 minute of switching on the power.

6.3 Extreme test conditions

Additional environmental requirements can be made in reference R1-06 (Network operator information).

The mobile unit should be tested at the lower and upper limits in the temperature and voltage ranges stated above.

Before testing is carried out, the equipment should have achieved thermal equilibrium in the test chamber. The power supply should be switched off during this period. Measurements should be carried out in such a sequence and with relative humidity controlled so that excessive condensation does not occur.

Testing at the upper temperature limit should begin with the sender in the send position for 1 minute and receiving for 4 minutes after which measurements are carried out.

Testing at the lower temperature limit should commence 1 minute after switching on the power supply.

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6.4 Test connections, interfaces and controls

For the type approval test, the mobile terminal should be equipped with test connections and manual controls to permit the measurements that are necessary to verify that the specification requirements are complied with. This applies particularly to the requirements stated in reference R1-18 ("Radio equipment, mobile terminals" and "Measurement methods"). These connections and controls can be implemented by external test adaptors during the test.

For the type approval test, the equipment should also be equipped with the "Machine interface (MASC)" as described in reference R1-19 ("Other interfaces, mobile terminal", minimum basic and type test functions). This interface can be implemented by an external test adaptor during the test.

Equipment intended to be used as partially active in MOBITEX should be possible to operate as a normal mobile terminal during the tests, i.e. continuously listening to MOBITEX.

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7 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

R1-06, 6
R1-09, 4
R1-18, 8
R1-19, 8

Below are the reference designations listed.

Reference	Section
R1-01	Arrangement of the documents
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R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
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